NUCLEAR DATA AND MEASUREMENTS SERIES

ANL/NDM-11

Measured and Evaluated Fast Neutron Cross Sections of Elemental Nickel

by

P. Guenther, A. Smith, D. Smith, J. Whalen, R. Howerton

July 1975

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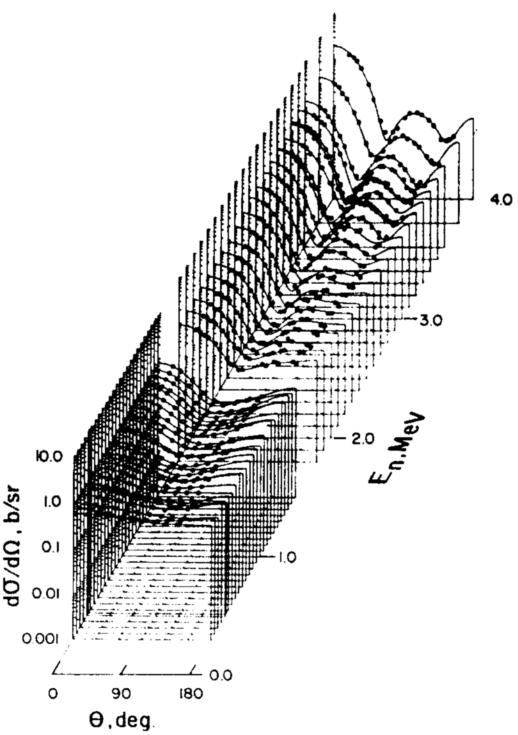

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In January 1975, the research and development functions of the former U.S. Atomic Energy Commission were incorporated into those of the U.S. Energy Research and Development Administration.

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NUCLEAR DATA AND MEASUREMENTS SERIES

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MEASURED AND EVALUATED FAST NEUTRON CROSS SECTIONS OF ELEMENTAL NICKEL*

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ABSTRACT

Fast neutron total and scattering cross sections of elemental nickel are measured. Differential elastic scattering cross sections are determined from incident energies of 0.3 to 4.0 MeV. The cross sections for the inelastic neutron excitation of states at: 1.156±0.015, 1.324±0.015, 1.443±0.015, 2.136±0.013, 2.255±0.030, 2.449±0.030, 2.614±0.020 and 2.791±0.025 MeV are measured to incident neutron energies of 4.0 MeV. The total neutron cross sections are determined from 0.25 to 5.0 MeV. The experimental results are discussed in the context of optical and statistical models. It is shown that resonance width-fluctuation and correlation effects are significant. The present experimental and theoretical results, together with previously reported values, are used to construct a comprehensive evaluated elemental data file in the ENDF format. Some comparisons are made with previously reported evaluated files. In addition, some selected reactions which are widely used in dosimetry and other applications are presented as supplemental evaluated isotopic-data files. The numerical quantities are presented in tabular form.

*This work is supported by the U.S. Energy Research and Development Administration.

I. INTRODUCTION

Nickel is widely employed in neutronic applications both in the elemental form and as a ferrous alloy (1). Some of the latter alloys are rich in nickel and particularly resistant to radiation damage. In view of this aplied usage, it is curious that the fast neutron cross sections of nickel are not well known. Indeed, only recently has the resonance behavior of the total neutron cross section been reasonably established in the several hundred-keV region (2).

Elemental nickel consists primarily of the two isotopes ^{58}Ni and ^{60}Ni. They are in the region of strong $\ell=0$ strength functions where resonance width-fluctuation and correlation corrections to the Hauser-Feshbach formula should be pronounced (3,4). These corrections are important at MeV energies where the excitation of a few discrete levels is a dominant feature of the inelastic scattering process. The width-fluctuation correction enhances the average cross section for reactions in which the entrance-and exit-channel fluctuations are correlated with a corresponding reduction in cross sections for reactions without such correlation. The low-energy excited levels of these isotopes exhibit the characteristics of two-phonon vibrational excitation and channel coupling between the ground and low-energy excited states may be appreciable. It is of interest to compare ellipsoidal-(coupled-channel) and spherical-optical model interpretations of the observed cross sections. Furthermore, the energy-averaged models can be related to the statistical properties of the fluctuating cross sections observed in high-resolution measurements with a consequent improved insight into the nature of the energy-averaged models (5).

Thus, from both basic and applied points of view, the interaction of fast neutrons with nickel is of considerable interest. It is the objective of the present work to examine such processes using experimental and calculational means and to use the results, together with those available from other sources, to construct an evaluated nuclear data file in the ENDF format for applied use (6). The following sections deal with: II) a brief outline of experimental methods, III) a summary of experimental results, IV) an interpretation of the present measured values in the context of optical and coupled-channel models including the statistical nature of the fluctuating structure and the implication of the energy-average models, and V) the formulation of the evaluated data files including a general elemental file and supplemental isotopic files. The complete numerical files are presented in the Appendix.

II. EXPERIMENTAL METHODS

The samples were cylinders of high purity metallic nickel. One set was selected to provide axial neutron transmissions of 50 percent or greater in the total cross section measurements. A second set consisting of 2 cm diameter and 2 cm long right cylinders was used for the scattering measurements with neutrons incident on the lateral surfaces. The samples had negligible chemical impurities.

Throughout the measurements the $^{7}Li(p;n)^{7}Be$ reaction was employed as a neutron source with the metallic-lithium film selected to provide the desired incident neutron energy resolutions.

The total neutron cross sections were deduced from the observed transmissions of approximately monoenergetic neutrons through the samples (7). The data were obtained from three separate sets of experiments distributed over a decade. The first set spanned the energy range 0.25 to 0.65 MeV. It utilized an automated facility and BF_3

neutron detectors (8). The second set of measurements extended from 0.50 to 1.50 MeV. The method was essentially the same as that of the first set with a proton-recoil scintillator replacing the BF_3 detectors. The recoil scintillator was biased to reject the second (minority) neutron group from the source reaction and gamma-ray sensitivity was suppressed with appropriate circuitry. The third set of measurements extended from 1.5 to 5.0 MeV. The method was essentially the same as employed below 1.5 MeV with the addition of time-of-flight techniques to control the background and reduce other experimental perturbations (9). Absolute energy scales were determined relative to the threshold of the neutron-source reaction with an estimated precision of a few keV. Much of the total cross section data was obtained in an energy-random manner which tended to mitigate systematic uncertainties.

The scattering measurements employed time-of-flight techniques using an 8-10 angle detection system (10). The scattered neutron velocity resolutions were in the range 0.4 to 1.0 nsec/m with the better velocity resolution at the higher incident energies. The scattering angles ranged from approximately 20 to 160 deg. At incident energies of $\lesssim$ 1.5 MeV measurements were made at 8 to 10 scattering angles distributed over the angular range. At higher incident neutron energies measurements were made at 16 to 20 scattering angles. The relative energy dependence of the detector efficiencies and the absolute values of the cross sections were measured relative to the H(n,n) process at energies > 1.5 MeV (11) and relative to the C(n,n) process at $\lesssim$ 1.5 MeV (12). All measured scattering cross sections were corrected for angular resolution, beam attenuation and multiple collision effects using Monte-Carlo procedures (13). All cross section values reported herein are expressed in units of barns per atom of the element unless otherwise specified. The particular apparatuses and procedures are described in detail elsewhere (8,9,10).

III. EXPERIMENTAL RESULTS[a]

1. Total Neutron Cross Sections

The total neutron cross sections were measured from 0.25 to 5.0 MeV. While the resolution of 2.0 to 2.5 keV was good, it was not in itself a goal. More attention was given to the accuracy of the energy-averaged magnitudes to provide a good foundation for the development of energy-averaged models and to assure accurate normalization of evaluated cross section sets. The statistical accuracies of the individual data points were in the range 1-2 percent and considerable attention was given to the minimization of systematic errors. The results are summarized and compared with the angle-integrated elastic scattering values and with the evaluated total cross section in Fig. 1. Below 1.5 MeV the present values are in good agreement with the white-source results of Perey et al. (2), considering that the latter have appreciably better resolution with correspondingly greater maxima. The present values may tend to have slightly lower minima. The energy scales appear consistent. Above 0.5 MeV the present values are in good agreement with the white-source results of Cierjacks et al. (14). The latter provide better resolution to about 2.0 MeV. At higher energies the resolutions of the present measurements are probably superior, and thus the data fluctuations are larger. The present values confirm, with a different technique, the major features and magnitudes of the two comparable sets of higher resolution white-source results. When broad energy-averages are constructed from these measured data

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a. All measured data reported herein has been transmitted to the National Neutron Cross Section Center, Brookhaven National Laboratory.

sets the agreement is particularly good. In addition, there is a number of more limited monoenergetic data sets that are consistent with the present experimental values (15).

2. Elastic Neutron Scattering Cross Sections

The differential elastic scattering cross sections were measured from 0.3 to 4.0 MeV. Below $\stackrel{\sim}{\sim}$ 1.5 MeV the incident neutron energy resolution was $\stackrel{\sim}{\sim}$ 20 keV and the measurements were made at intervals of $\stackrel{\sim}{\sim}$ 20 keV. The estimated uncertainties were 10 to 15 percent. Above 1.5 MeV cross sections were determined at 100 to 200 keV incident energy intervals with resolutions of 30 to 50 keV and estimated uncertainties of 5 to 10 percent or 3 mb/sr, whichever was larger. Factors contributing to these uncertainties varied from measurement to measurement but were generally: 1) sample counting statistics, < 1 to 5 percent, 2) detector normalization procedures, < 3 to 8 percent, 3) uncertainties in reference standards of 1 percent for H(n,n) and 6 percent for C(n,n), and 4) systematic uncertainties associated with geometrical factors (e.g., scattering angle determination) and multiple event corrections collectively amounting to 1 to 3 percent.

The measured differential elastic angular distributions were least-square fitted with Legendre polynomial series. The fitting procedures were based upon the measured values with the addition of a few 180 deg. theoretically deduced cross sections at higher incident energies in order to assure a well behaved extrapolation beyond the measured angular range. The results of the fitting were generally consistent with "Wick's Limit" (16). The angle-integrated elastic cross sections, obtained from the fitting procedures were believed known to $\lesssim$ 10 percent with the better accuracies corresponding to the higher energies. They were generally consistent with the observed total cross sections, as illustrated in Fig. 1, particularly demonstrating an intermediate fluctuating structure similar to the energy-average behavior of the better-resolution total cross section results.

Energy-dependent structure was very evident in the differential elastic distributions, decreasing in magnitude with increasing energy and approaching a smooth behavior at 4.0 MeV. Below 1.5 MeV, these fluctuations were so pronounced that it was difficult to correlate measurements made with slightly different experimental incident energies and/or resolutions or to compare the present results with those reported elsewhere. Therefore the experimental differential distributions were averaged over incident energy intervals of $\approx$ 50 keV. The results are summarized in Fig. 2. Expressed in this form the distributions reasonably portray intermediate structure effects and are more comparable with previously reported results. Some of the latter comparisons are shown in Fig. 3. Below 1.5 MeV the present work is only qualitatively consistent with that of Korzh et al. (17), Cox (18) and Walt and Barschall (19). The differences were attributed to the residual effects of structure in the context of the experimental resolutions of the various measurements. From 1.5 to 4.0 MeV the present results compare reasonably well with those of Holmqvist and Wiedling (20), Tsukada et al. (21) and Mackwe et al. (22). Where there are differences they are usually within the respective experimental uncertainties, often at lower energies and/or correlated with observed structure in the high resolution total cross section. An example of the latter effect is illustrated by the results near 1.8 MeV where there is a pronounced "bump" in the total cross section (See Fig. 1) which corresponds to the energy of an angular distribution measured in the present work which differs from results at slightly lower energies reported in Ref. 20.

3. Inelastic Neutron Scattering Cross Sections

The energies of the inelastically scattered neutrons were determined from measured flight times and flight paths and the known incident energy and verified by the observed excitation of well known inelastic neutron scattering processes in other nuclei (e.g., the 846 keV state in ^{56}Fe). The accuracies of the excitation energies determined in this manner were approximately 10 to 30 keV. The present results are compared with previously reported values for ^{58}Ni, ^{60}Ni and ^{62}Ni, as summarized in the Nuclear Data Sheets (23), in Fig. 4. Some of the spectroscopic techniques employed in previous work are capable of determining level energies with greater accuracy than the present measurements and therefore the previously reported excitation values are preferred for the interpretation of Sec. IV and evaluation of Sec. V. Angle-integrated inelastic excitation cross sections were deduced from the measured differential values by least-square fitting a Legendre polynomial series to the observed angular distributions. The estimated accuracies of the resulting cross sections were generally 5 to 15 percent for scattered-neutron energies greater than $\approx$ 0.7 MeV. Lower energy scattered neutrons were routinely observed but the corresponding cross sections were felt to be unreliable due to uncertain detector sensitivities and limited angular information. The cross section results are summarized and compared with previously reported values in Fig. 5.

The observed levels at 1.156±0.015, 1.324±0.015 and 1.443±0.015 MeV were attributed to the first-excited states in ^{62}Ni(1.17 MeV), ^{60}Ni(1.33 MeV), and ^{58}Ni(1.45 MeV), respectively. The cross section magnitudes were in general agreement with those obtained in the direct neutron measurements of Tsukada et al. (21) and Boschung et al. (24), Rodgers et al. (25), Perey et al. (26) and Cranberg and Levin (27). The agreement with a number of results of (n;n',γ) measurements is not as satisfactory; particularly where uncertainties in gamma-ray branching ratios become a contributing factor (28,29,20,31). The fluctuation in the cross section values, particularly in the context of the prominent 1.45 MeV state, was large indicating the presence of an intermediate resonance structure. In such an environment, measurements made with only slightly differing incident energies and/or resolutions can give appreciably different results. Furthermore, the structure evident in the total cross section should be selectively enhanced in the individual inelastic channels and preliminary results of detailed (n;n',γ) studies by D. Smith support this premise (32). Similar structure is well known in similar inelastic processes (e.g., the excitation of the 846 keV state in ^{56}Fe).

The excitation of the 2.136±0.13 and 2.255±0.030 MeV states was primarily attributed to reported levels in ^{60}Ni (2.16 and 2.28 MeV). In addition, there was probably some minor contribution from 2.05, 2.29 and 2.33 MeV states in ^{62}Ni that would not have been resolved from the primary ^{60}Ni contribution in the present experiments. The measured cross section values were generally consistent with previously reported results, particularly those of Tsukada et al. (21).

Observed neutrons corresponding to an excitation of 2.449±0.030 MeV were attributed to contributions from the reported 2.46 and 2.51 MeV states in ^{58}Ni and ^{60}Ni, respectively. The resolutions of the present experiments would not resolve the two components. The measured results are consistent with those reported by Boxchung et al. (24) but possibly somewhat lower than the (n;n',γ) values of Ref. 31.

The observed excitations of states at 2.614±0.020 and 2.791±0.030 MeV were well correlated with known levels in ^{60}Ni(2.63 MeV) and ^{58}Ni(2.77 MeV), respectively. The former are in good agreement with the values reported by Perey et al. (26). However, the present cross sections for the excitation of the 2.77 MeV are not consistent with those deduced from the (n;n',γ) measurements of Ref. 31 even considering the relatively large uncertainties in the present work.

In addition to the above, neutrons were observed corresponding to the excitation of states above 2.8 MeV. These were not well resolved because of an increasingly complex structure and the cross sections were relatively uncertain. Therefore, these results were not interpreted.

IV. INTERPRETATION AND DISCUSSION

1. The Optical Model and Elastic Scattering

The observed energy-averaged neutron total and elastic scattering cross sections were examined in the context of the optical model (33,34). Parameter selection was based upon comparisons of measured and calculated total and elastic scattering cross sections. The calculated values included compound nucleus contributions determined with the Hauser-Feshbach formula (3) corrected for resonance width fluctuation and correlation effects (4). Over a large portion of the energy range of interest, both total and scattering cross sections fluctuated by large amounts. Therefore, the measured values were averaged over $\approx$ 0.2 MeV energy intervals before making comparisons with calculated results and more emphasis was given to energies above $\gtrsim$ 2.0 MeV where the fluctuations were less pronounced.

An initial attempt to select optical potential parameters from χ-square fitting to the observed elastic angular distributions proved unrewarding. The description of individual distributions was generally good but the resulting parameters were sharply dependent upon the incident energy due to the persistence of intermediate fluctuations even in the 0.2 MeV energy average of the measured values. Therefore, the potential was subjectively selected from concurrent comparisons of measured and calculated total and elastic scattering cross sections. Two different potential models were used as starting points for the calculations: 1) that of Moldauer (35), primarily applicable in the lower energy region, and 2) that of Holmqvist and Wiedling (20), more suitable at higher energies regardless of reasonable parameter adjustment. The Holmqvist and Wiedling potential was useful for the extrapolation of various experimental results in the high energy region. Therefore, it was accepted for use in the subsequent computations. The parameter values are given in Table 1. The total cross sections calculated with this potential agree within a few percent with the experimental values at energies above $\sim$ 2.0 MeV as illustrated in Fig. 6. The parameters were not energy dependent and the introduction of such a dependence as suggested, for example, by Engelbrecht and Fiedeldey (36) led to some degradation in the description of experiment. This was probably an artifact of the particular potential and energy range since an energy dependence is a characteristic of broader-scope studies. Below about 2.0 MeV the calculated total cross sections were somewhat larger than the energy-averaged experimental results. This behavior is rather characteristic of this type of potential (relatively large real depth, $\approx$ 50 MeV, and narrow radius) in this mass-energy region. Improved descriptions of total cross sections in this region are obtained using the potentials more of the Moldauer form (relatively smaller real depth, $\approx$ 45 MeV, and larger radius). However, it is an area where large fluctuations make quantitative comparison with an energy-averaged model difficult and where data for applications must be primarily based upon experimental values. Both types of potentials resulted in calculated $\ell=0$ strength functions of $\approx 5 \times 10^{-4}$, consistent with the values reported from resonance measurements and systematics (37).

The calculated elastic-scattering cross sections were sensitive to the compound-nucleus contribution throughout the range of the present measurements. This contribution is enhanced by width-fluctuation effects and reduced by resonance correlations. These opposing corrections to the Hauser-Feshbach formula were estimated using the approximations of Moldauer (4) and the computer code NEARREX (38). The results were sensitive to the overlap parameter, Q, which was adjusted to obtain the overall best agreement between measured and calculated elastic and inelastic scattering cross sections. These comparisons indicated a Q of 0.7 to 0.8 as illustrated by the example of Fig. 7. This range is reasonable in the context of the structure evident in the measured quantities (e.g., total cross section). Using Q=0.75 the calculated elastic distributions generally compared well with the measured results of the present work as illustrated in Fig. 3. At the lower energies ($\lesssim$ 1.5 MeV) the fluctuations are large and some differences are to be expected. At higher energies where the fluctuations are smallest, the agreement with the present measured values is good. The model was not explicitly adjusted to describe previously updated elastic scattering results at energies above 4.0 MeV. However, the calculated distributions were representative of measurements as illustrated by the results at 6.0 and 8.0 MeV shown in Fig. 3. More exact parameterization can be obtained at a given energy with detailed adjustment of parameters but at the expense of the overall description. Indeed some specifically tailored parameter sets reported in the literature were found deficient in a broader energy context. Calculated 14 MeV distributions were similar to reported measured values (39,40,41) with discrepancies largely in the details of the diffraction patterns where the experimental results themselves are ambiguous. At these high energies collective vibrational direct-reactions probably contribute to the elastic processes. These were estimated, using a coupled-channel calculation based upon the above potential (42). The inelastic scattering contribution was small at the energies of the present measurements and not a significant factor in the context of elastic scattering (less than uncertainties associated with unknown level structures).

2. The Statistical Model and Inelastic Scattering

The inelastic excitation cross sections were calculated using the above optical potential and the Hauser-Feshbach formula with corrections (3,4). The choice of optical parameters was not explicitly influenced by considerations of inelastic scattering but the selection of the overlap parameter, Q, was made in concert with the considerations of elastic scattering as outlined above. It was assumed that the elemental inelastic scattering was entirely due to ^{58}Ni and ^{60}Ni as more than 94 percent of the element consists of these isotopes. The spectroscopic characteristics of these two isotopes are well known to excitation energies above 3.0 MeV (see Fig. 4) but at higher energies become increasingly uncertain with a corresponding unreliability of the calculated results. The region of uncertainty is generally above the energy range of the present measurements. The calculated results are summarized and compared with the measured values in Fig. 5.

The observed excitation of the 1.17 MeV state was attributed to scattering from ^{62}Ni and not considered in the present calculations. However, the measured values were approximately 15 percent of those calculated for the 1.33 MeV state attributed to ^{60}Ni as expected.

The observed 1.33 and 1.45 MeV states are similar first-excited (2+) levels in ^{60}Ni and ^{58}Ni, respectively. Their calculated excitation functions are similar up to $\sim$ 2.2 MeV then become different as varying channel competition sets in. The results of both calculations are qualitatively similar to the measured values but there are detailed discrepancies (particularly evident in the case of the prominent 1.45 MeV state) which are attributed to the fluctuating structure near thresholds (as noted in Sec. III above). In view of these uncertainties, the calculated results, largely based upon considerations of neutron total and elastic scattering cross sections, were judged acceptable. As expected, the calculated values become increasingly larger than the measured quantities above 4.0 MeV due to omission in the calculations of unknown competing neutron channels.

The observed 2.15 (2+) and 2.28 (0+) MeV states are primarily due to known levels in ^{60}Ni with additional and unresolved small contributions from 2.05, 2.29 and 2.33 MeV levels in ^{62}Ni. The calculated and measured excitation cross sections for the 2.15 MeV state are in good agreement. The calculated results for the excitation of the 2.28 MeV state are smaller than the measured values by an amount consistent with the contribution from the 2.29 and 2.33 MeV states in ^{62}Ni, not included in the calculations. Indeed, the observed angular distribution of scattered neutrons resulting from the 2.28 MeV excitation was anisotropic in the manner characteristic of a 0+ excitation but not to the degree indicated by calculation assuming contribution from a single level. This also would be expected from some additional contributions from ^{62}Ni.

The observed neutrons corresponding to the excitation of a 2.48 MeV state were assumed to be the sum of ^{58}Ni(2.46 MeV,4+) and ^{60}Ni(2.51 MeV,4+) contributions. Calculations based upon this premise gave results consistent with the experimentally observed cross sections of the present experiment to energies of $\gtrsim$ 4.0 MeV. At higher energies the calculated results became increasingly too large, again probably due to the neglect of unknown competing neutron channels.

The measurements did not well define the cross sections for the excitation of the 2.63 MeV and 2.77 MeV states. However, calculated results based upon the premise of contributions from ^{60}Ni(2.63 MeV,3+) and ^{58}Ni(2.77 MeV,2+), respectively, were in reasonable agreement with the experimental values.

The above calculated results were based upon a spherical optical potential and the compound-nucleus model. However, the first excited states of the two prominent even isotopes (^{58}Ni and ^{60}Ni) are attributed to two-phonon vibrational configurations (23,43). Therefore, collective-direct excitations can contribute to the observed scattering processes. This was estimated using coupled-channel calculations assuming a deformation parameter, β_2 = 0.187 and a vibrational coupling of ground

(0+) and first excited (2+) states (44). At the energies of the present measurements the direct contribution was not large as illustrated by the comparison of dashed and dotted curves for the excitation of the 1.45 MeV state shown in Fig. 5. The anisotropy in the scattered neutron angular distributions predicted by the coupled-channel calculations was not recognizable in any of the present measurements and generally of the order of the experimental uncertainties. Moreover, the possible effect is masked by the apparent fluctuations, noted above, and by uncertainties associated with the physical mechanisms involved in the compound nucleus processes. The direct component is a major contribution and clearly evident at incident energies well above those of the present experiments. Examples are found in the cross section magnitudes and angular distributions associated with the excitation of the first (2+) states by 14 MeV incident neutrons as reported by Stelson et al. (45), Clark et al. (46) and Kammerdiener (39). These experimental data at 14 MeV were consistent with the results of the coupled-channel calculations.

All of the above compound-nucleus calculations, for both elastic and inelastic scattering, employed the Hauser-Feshbach formula with the correction factors suggested by Moldauer (4). The latter are recognized as qualitative approximations. However, it is clear that such correction factors appreciably influence the comparisons of calculated and measured values and thus the basic model selection. More definitive model determination will probably require a better understanding of these correction factors. Such is now being sought, for example, by Moldauer (47), Kawai et al. (48) and Weidenmüller (49). Wide application of these new physical concepts will require the development of practical computational tools for experiment analysis.

V. THE EVALUATED FILE

The above experimental and calculational results, together with previously reported information, were utilized to construct a comprehensive evaluated data file in the ENDF/B format (6). The objective was to make available the most recent information in a form suitable for applied use. This evaluation was confined to energies greater than 100 keV. For completeness, the file was extended to lower energies explicitly using the preliminary version of ENDF/B-IV formulated by M. Bhat (6). In addition to the general elemental file, selected isotopic files were formulated where they referred to specific reactions that are often employed on an isotopic basis (e.g., in dosimetry applications). The elemental file was constructed from these isotopic components where appropriate. The derivation of the present file is outlined in the subsequent text and the numerical values are given in the Appendix. Throughout, attention was given to both physical content and conciseness.

1. Total Neutron Cross Sections

From 0.1 to 0.5 MeV the data base for the present evaluation was obtained from Refs. 2,50,51,52 and the present work. Ref. 2 appeared to be of the best quality and the more comprehensive therefore was given the primary emphasis. A large-scale graphical representation of these data was assembled and points selected from the measured values so as to give a clear representation of the results with a good degree of conciseness. This procedure resulted in a very good description of the measured values. Above 0.5 MeV the present evaluation was based primarily upon data from Ref. 14. The general character of the structure and the energy-averaged magnitudes of that work were verified by the present measurements and those reported in Refs. 15,53 and 54. Data from Ref. 55

tended to have a lower average magnitude and was not used. The resolution of the data of Ref. 14 appeared very good, and the energy scale was consistent with the results of isotopic measurements given in Ref. 56. The evaluated file in this higher energy region was derived by the same point selection method outlined above to 6.0 MeV. Above 6.0 MeV the data becomes smooth and the file was constructed from energy-averages of the measured values over intervals of 25 keV or larger.

The results of the present evaluation are compared with those of ENDF/B-IV in Fig. 8. Below energies of approximately 0.7 MeV ENDF/B employs a resonance-parameter description and the results are not directly comparable with the point values of the present work. Above 0.7 MeV the two evaluations are similar, though a careful inspection indicates that the present file gives a slightly improved description of the fluctuating structure with, particularly, higher resonance maxima.

Due to the sharp resonance structure over much of the energy range of the file, error estimates are difficult. Undoubtedly, at some future date improved measurements will result in larger maxima and lower minima as suggested by theoretical statistical calculations (5). However, it is unlikely that the energy-averaged magnitudes of the evaluated file will change by more than 3 to 5 percent and, but for a few lower energy regions, the extrema may not change by more than 20 percent.

2. Elastic Neutron Scattering Cross Sections

The evaluated elastic scattering cross sections were primarily based on data from experiments to $\sim$ 8 MeV and near 14 MeV. Theory was used to extrapolate and interpolate where necessary, particularly from 8 to 14 MeV and 14 to 20 MeV. Below 0.3 MeV, the recent experimental results of Zuhr (57) were given primary emphasis. They are consistent with the results of Ref. 12 and the resolution was sufficient to define intermediate fluctuating structure. From 0.3 to 4.0 MeV primary reliance was placed upon the present experimental work supported by the results of Cox (18), Walt and Barschall (19), Tsukada et al. (21) and Holmqvist and Wiedling (20). Some of these experimental results are compared in Fig. 3. Evaluated differential cross sections at 5.0, 6.0, 8.0 and 14.0 MeV were constructed from the measured values of Perey et al. (26), Boschung et al. (24), Holmqvist and Wiedling (20), Clark and Cross (41), Kammerdiener (39) and Bauer et al. (40). The experimental data base above 5.0 MeV was generally available at slightly different incident energies. Measured values were combined in the evaluation when the incident energies were within ± 10 percent of a given median value. Generally the incident energies were much closer and an effort was made to balance high and low energy results about the mean.

The angle-integrated elastic cross sections were obtained by least-square fitting a Legendre polynomial series to the measured values. The 0 deg. cross section value was constrained to exceed the minimum set by "Wick's Limit" (16),and 180 deg. values deduced from the model of Sec. IV, were introduced to assure a well behaved shape. The same model was slightly "tailored" to give good description of 8.0 and 14.0 MeV experimental results and then used to interpolate between 8.0 and 14.0 MeV and to extrapolate to 20 MeV assuming shape scattering only.

The evaluated angle-integrated elastic cross sections were consistent with other known partial cross sections and the total cross sections up to about 4.0 MeV. Above 4.0 MeV the difference between total cross section, and the elastic cross section and observed partial cross sections defined the continuum inelastic cross section. The final evaluated elastic cross section was determined by subtracting the observed nonelastic cross section from the total cross section. This procedure is necessary to achieve the manadatory internal consistency of the file. Unfortunately, it has the physically consequence of reflecting nearly all the detailed structure of the total cross section to the elastic channel. There is little alternative in the absence of high resolution data in all channels and with the requirement of absolute internal consistency. The final evaluated result is summarized and compared with that of ENDF/B-IV in Fig. 9.

The evaluated angular-distributions of elastically scattered neutrons are expressed as f coefficients where

$$\frac{d\sigma}{d\Omega} = \frac{\sigma}{2\pi} \sum_{\ell=o}^{n} \frac{2\ell+1}{2} f_\ell P_\ell \qquad (1)$$

and P_ℓ are Legendre polynomials expressed in the center of mass system. The coefficients are based upon experimental values extrapolated by theory as outlined above. They satisfy "Wick's Limit" (16). The energy resolutions associated with the angular distributions are $\gtrsim$ 50 keV, i.e., much coarser than those of the angle-integrated cross sections. However, the angular distributions do show intermediate fluctuations as evident in the energy dependence of the distributions shown in Fig. 10. The absence of detailed resonance behavior of the angular distributions may lead to some problems in special applications.

The estimated uncertainties in the evaluated angle-integrated elastic scattering cross sections are 5 to 10% up to 8.0 MeV and near 14.0 MeV, regions where there is experimental information available. The uncertainties may be larger in the regions of theoretical interpolation and extrapolation (i.e., 8.0–14.0 MeV and > 14.0 MeV). The uncertainties in the relative angular distributions are qualitatively of the same magnitudes. The file requires internal consistency, thus there is generally a built-in correlation of total and partial cross section uncertainties.

3. Inelastic Neutron Scattering Cross Sections

The evaluated inelastic scattering cross sections are treated as discrete excitation functions from threshold to energies of 3.628 MeV. At higher excitation energies the inelastic neutron process is attributed to a continuum of states with the emission of both precompound- and compound-nucleus inelastic neutron spectra. These two types of inelastic neutron processes are dealt with in the following subtitles, A and B.

A. Discrete Excitation Cross Sections

The energetics of these contributions are based on the spectroscopic values of Ref. 23 as defined in Table 2. The evaluated cross sections are compared with the underlying data base in Fig. 3. The specific components are as follows:

E_X = 1.172 MeV, ^{62}Ni

The evaluation is based upon the present experimental results and those of Tsukada et al. (21) and of Rogers et al. (30). This experimental information is for incident energies of $\lesssim$ 3.0 MeV. At higher energies the evaluation relies on theoretical extrapolation and analogy with results experimentally determined for the similar first excited (2+) states in ^{58}Ni and ^{60}Ni. The neutron emission is assumed isotropic to 4.0 MeV and then becomes anisotropic as direct reactions become appreciable. The degree of anisotropy is derived from model calculations as discussed below for the 1.33 and 1.45 MeV states. No attention is given to the probable presence of fluctuating structure. The latter assumption is an over simplification but will probably have little impact on most applications of the file. The cross-section uncertainties for the excitation of this state are relatively large, 30-50%, but the absolute-uncertainty magnitudes are small, $\lesssim$ 20 mb.

E_X = 1.333 MeV, ^{60}Ni

The excitation of this state has been observed experimentally to $\approx$ 8.0 MeV and at $\approx$ 14 MeV in both (n;n') and (n;n',γ) measurements. The evaluation relies on experimental values interpolated with theory. The approach to threshold from 2.0 MeV is based upon the results of Rogers et al. (30), Sluchaevskaya (31) and D. Smith (32). Primary emphasis is given to the latter. They are relative values, normalized to neutron scattering results at $\approx$ 2.0 MeV, but are in sufficient detail to give an indication of the appreciable fluctuations that must be present. From 2.0 to 8.0 MeV the evaluation is based upon the experimental values of the present work, those of Boschung et al. (24), Tsukada et al. (21), Rogers et al. (30), Day (28), Scherrer et al. (29), Rodgers et al. (25), Sluchaevskaya (31), and Perey et al. (26). The evaluation is extrapolated above 8 MeV using theory adjusted to be consistent with the $\approx$ 14 MeV experimental values of Kammerdiener (39) and of Stelson et al. (45). The latter two sets of measurements represent the composite excitations of 1.333 (^{60}Ni) and 1.452 (^{58}Ni) states. The present experimental studies, supported by other measured values, indicate that the neutron emission is essentially isotropic below $\lesssim$ 4.0 MeV and this is assumed in the evaluation. Above 4.0 MeV the observed scattered neutron distributions become increasingly anisotropic (see for example the work of Boschung et al. (24), Perey et al. (26), Stelson et al. (45) and Kammerdiener (39)). These experimental distributions were fitted with Legendre polynomial series. The latter were smoothed and interpolated using coupled-channel calculations and then used to provide the angular distributions for the evaluation. Below $\sim$ 5.0 MeV the energy-averaged of the evaluated cross sections were estimated to have an uncertainty of $\lesssim$ 15%. Above 5.0 MeV the estimated error becomes larger, perhaps as much as 30% at 20.0 MeV. Near threshold the evaluation is deficient in describing the resonance fluctuations and one may expect future high resolution measurements to show fluctuations about the energy-averaged values of as much as an order of magnitude.

E_X = 1.454 MeV, ^{58}Ni

This state is the 2+, ^{58}Ni, complement of the similar 1.333 MeV state in ^{60}Ni (see above). The data base consists of the present measurements and those of Tsukada et al. (21), Rodgers et al. (30), Day (28), Scherrer et al. (29), Rogers et al. (25), Sluchaevskaya (31), Boschung et al. (24) and Perey et al. (26). In addition, the composite excitations of the 1.333 and 1.454 MeV states at 14 MeV reported by Stelson et al. (45) and Kammerdiener (39) were considered. An indication of the partially resolved structure below 2.0 MeV was obtained from the relative (n;n',γ) measurements of D. Smith (32). Even above this energy, there is an indication of the persistence of unresolved resonance fluctuations the definition of which is beyond present experimental information. Therefore, the evaluation follows an energy-averaged above $\sim$ 2.0 MeV. The extrapolation to 20.0 MeV and the treatment of emitted neutron angular distributions were identical to that described above for the excitation of the 1.333 MeV state. The estimated error in the energy-average of the evaluation is 15% below 5.0 MeV increasing to as much as 20-30% at 20.0 MeV.

E_X = 2.158 MeV and E_X = 2.286 MeV, ^{60}Ni

The evaluation is a subjective estimate of the energy-averaged behavior of the cross section deduced from the experimental results of the present work, those of Tsukada et al. (21), Day (28) and Sluchaevskaya et al. (31). These experimental results extend to $\approx$ 4.5 MeV. The extrapolation to higher energies is guided by theory and made consistent with the combined excitations of the 2.158 and 2.284 MeV states reported by Perey et al. (26). The estimated uncertainty over the entire energy range is $\approx$ ± 20%. The neutron emission was assumed to be isotropic for this and all subsequent excitations.

E_X = 2.459 MeV, ^{58}Ni and E_X = 2.506 MeV, ^{60}Ni

There is little experimentally resolved data on the cross sections for the excitation of these two states. In the present work, that of Sluchaevskaya et al. (31) and of Boschung et al. (24) the cross sections are determined as a composite. Perey et al. (26) observed the excitation of the 2.506 MeV and subsequent 2.625 MeV state in ^{60}Ni as a composite. Tsukada et al. (21) have reported the excitation of the isolated 2.459 MeV and 2.506 MeV states at only a few energies. However, the J^{π} values of these excited states in both ^{58}Ni and ^{60}Ni are reasonably well known. Therefore, the present evaluation is based upon the measured cross sections for the composite excitation broken into the two respective components by a ratio factor calculated from the above model. The results are consistent with the available experimental information. The uncertainty in the individual excitation cross sections may be rather large (up to 50%) but the estimated error in the composite is smaller ($\sim$ 20%) and it is the latter uncertainty that will be relevant to most applications.

E_X = 2.625 MeV, ^{60}Ni

The available experimental information is from the present work and that of Scherrer (29). Supporting evidence are the results of Boschung et al. (24) and Perey et al. (26) which include contributions from the 2.506 MeV state. This rather meager experimental information was extrapolated using theory to obtain the evaluated excitation cross section. The result may have a large error (30-50%) but this will be of little note in most applications due to the small magnitude of the cross sections.

E_X = 2.775 MeV, ^{58}Ni

The evaluation is primarily based upon the present experimental results extrapolated with theoretical estimates. The result is very much larger than indicated by the measurements of Ref. 31. The uncertainties in the evaluation may be large (as much as two).

E_X = 2,901, 2.942 and 3.038 MeV, ^{58}Ni

There is very little direct experimental evidence dealing with these states. For this evaluation we rely upon model calculations assuming the above potential and the J^{π} values of Ref. 23. The calculational estimates should be qualitatively valid (± 30%). In view of these uncertainties, we treat the three levels as a single composite state in this evaluation with a mean excitation energy of 2.960 MeV.

E_x = 3.123, 3.184, 3.195, 3.270, 3.316 and 3.392 MeV, ^{60}Ni and the 3.264 and 3.420 MeV, ^{58}Ni

The cross sections for the excitation of the ^{60}Ni components have been reported by Perey et al. (26). Additional measured values are given by Boschung et al. (24). The individual excitation functions have not been resolved. For this evaluation we assume a mean composite excitation energy of 3.270 MeV and use theory for the extrapolation of measured values particularly where associated with the excitation of the 3.264 and 3.420 MeV states in ^{58}Ni. The uncertainties in the resulting evaluated cross sections are estimated to be $\lesssim$ 30%.

E_x = 3.526, 3.531, 3.593 and 3.620 and 3.775 MeV, ^{58}Ni and 3.588, 3.618, 3.670 and 3.732 MeV, ^{60}Ni

The available experimental information is apparently limited to the measured cross sections for the composite excitation of the ^{60}Ni states reported by Perey et al. (20). The present evaluation uses these measured ^{60}Ni values and the theoretically-calculated excitations of the contributing ^{58}Ni states to obtain the excitation cross section of a "state" at an average energy of 3.628 MeV. The primary uncertainty is in the calculation of the ^{58}Ni contribution. The uncertainty in the evaluation is estimated to be $\simeq$ 30%.

The cross sections for the excitation of higher energy states in ^{60}Ni are available from the experimental measurements of Perey et al. (26). However, the larger contributions from ^{58}Ni are unknown and uncertainties in J^{π} values make calculations unreliable. Therefore, the present evaluation is confined to discrete excitation functions corresponding to states at energies of $\lesssim$ 3.7 MeV. Higher energy excitations are treated as continuum distributions as described below.

The above discrete inelastic excitation cross sections are compared with a number of those given in ENDF/B-IV in Fig. 11. The sum of discrete inelastic cross sections of the present evaluation is very similar to that of ENDF/B-IV below 5.0 MeV but there are some appreciable differences between specific excitation functions. Generally, the present evaluation tends toward larger discrete inelastic cross sections at very high energies (e.g., 10-20 MeV). This is a physically acceptable representation of direct excitations which is substantiated by experimental observation and by theoretical estimates. These high-energy cross section components will contribute to a harder emission spectrum at high incident energies than indicated by the simple temperature distribution.

B. Continuum Excitation Cross Sections

The evaluated continuum inelastic cross sections extend from the last discrete inelastic threshold (E_X = 3.628 MeV) to 20.0 MeV. The cross section magnitudes are the differences between the evaluated total cross section and the sum of other identified partial cross sections. Thus the continuum component may also include otherwise unidentified partial cross sections. This is unavoidable when file internal consistency is mandatory and all partial components may not be fully known. The uncertainties in the cross section magnitudes are estimated to be $\lesssim$ 30 percent and are, of course, correlated with those of other cross sections.

The neutron emission spectrum was assumed to consist of three components: 1) discrete neutron groups, 2) a temperature distribution due to compound-nucleus decay, and 3) a pre-quilibrium continuum distribution. The first of these is defined in Topic A, above. The second component was described by a Maxwellian temperature distribution (58) defined by

$$N(E) \sim E \exp(-E/T)$$

where (2)

$$T \propto \sqrt{E}.$$

The third, pre-equilibrium, component has been the subject of recent study by Griffin (59), Cline and Blann (60) and others. The process is usually formulated in the context of few-particle statistical models describing the intermediate configurations between the initial transitory particle excitation and the final long-lived compound nucleus. These pre-equilibrium models successfully describe observed emission spectra. However, a large number of uncertain parameters are involved thus making predictions based largely on the models somewhat uncertain and difficult to apply in pragmatic evaluation. As an alternative the present evaluation represents the pre-equilibrium emission with a "hard" temperature distribution. Thus, the full continuum spectrum is given by

$$N(E) \sim A \cdot E \cdot \exp(-E/T_A) + B \cdot E \cdot \exp(-E/T_B) \quad (3)$$

where (A) and (B) refers to compound nucleus and pre-equilibrium contributions, respectively. The choice of parameters is based upon experimental comparisons. The results of Mathur et al. (61), Voiginer et al. (62) and Perey et al. (26) primarily influenced the selection of compound-nucleus (A) parameters. The selection of pre-equilibrium (B) parameters were largely based on comparisons with the experimental results of Seeliger et al. (63) and Kammerdiener (39) and considerations of spectra obtained in sphere transmission "bench mark" experiments at 14 MeV (64). The compound-nucleus temperature (T_A) was assumed to have a $\sqrt{E}$ dependence with the proportionality constant determined from experimental comparisons. The pre-equilibrium temperature (T_B) was assumed constant, a reasonable approximation in view of other uncertainties. The finally selected parameter values were:

	Rel. Magnitude	Temp.(MeV)
Compound-Nucleus	$A = 5.0$	$T_A = 0.334 \cdot \sqrt{E}$
		(4)
Pre-equilibrium	$B = 0.075$	$T_B = 7.0$ MeV

These values are consistent with the available experimental information and with compound-nucleus parameters reported elsewhere (see, for example, Ref. 26).

All of the continuum distributions were step-wise terminated at the inset of the discrete excitation contributions. This physically anomalous behavior is an artifact of the transition between the two types of representation and should not effect most applications.

The evaluation assumes the continuum neutron emission to be isotropic in the laboratory system. This is reasonable in the context of compound-nucleus contributions but a gross approximation of the pre-equilibrium processes. The latter are characteristically peaked forward (e.g., see Kammerdiener, Ref. 39). However, quantitative definition of anisotropy from the presently available experimental and theoretical knowledge of scattering from nickel would be highly speculative and not of appreciable value for many applications.

The present evaluated inelastic cross sections are very different from those of ENDF/B-IV in the higher energy region as illustrated in Fig. 12. The discrepancy is nearly a factor of two at 14 MeV and above. This is primarily due to larger contributions from several partial emission reaction channels in the present estimates. Prominent among these is the (n;n',p+p,n') reaction where the present evaluation is much larger than that of ENDF/B-IV as discussed below. In addition, there are several reaction channels in the present work that were not included in ENDF/B-IV. With a well known total cross section and a reasonably known elastic scattering cross section these various other partial cross sections primarily interact with and reduce the inelastic scattering cross section. As noted below, some of these components are uncertain and may be overestimated in the present evaluation. Consequently, the present evaluated inelastic cross section at energies of $\gtrsim$ 14 MeV may be uncertain by as much as 25-50%. However, this large uncertainty remains much smaller than the discrepancy with the high energy inelastic cross sections of ENDF/B-IV. This difference may have an important effect on high energy applications such as CTR blanket studies.

4. Radiative Neutron Capture

The evaluation is generally based upon the data of Ref. 65 to 72. Below $\sim$ 0.5 MeV the evaluation follows the recent high-resolution results of Le Rigoleur et al. (65). There is a small ($\sim$ 20 keV) energy gap in the Le Rigoleur et al. results near 200 keV which was bridged with a speculative structure following the general data trend. From 0.5 to 1.0 MeV the evaluation follows the energy-average results of Diven et al. (67) and it is extrapolated to higher energies following the measured values of Poenitz (72).

The energy average of the present evaluation is consistent with that of Moxon (66) to 1.0 MeV and reasonably similar to the ENDF/B-IV values from 0.7 to 1.0 MeV. Above 1.0 MeV, the present results tend to be somewhat larger than those of ENDF/B-IV. The structure in the present evaluation at energies below 0.7 MeV is not directly comparable with that of ENDF/B-IV as the present work is based on direct experimental observation and that of ENDF/B apparently on a resonance extrapolation using systematics.

It is remarkable that present experimental knowledge of nickel fast neutron radiative capture is so sparse. This has been recognized and work now in progress at ANL by Poenitz (72) is improving the situation in the particularly uncertain region above several hundred keV. Until these, and similar, new experimental results become available in final form, the present evaluation must be considered tentative with uncertainties of 20 percent or more over much of the energy range. In addition, it is expected that some future high-resolution measurements will show pronouncedly larger fluctuations in the lower energy region ($\lesssim$ 1.0 MeV). This is particularly so as the available experimental information in the structured region may be influenced by scattered-neutron perturbations.

5. (n;X) Reactions

Energetically possible (n;X) reactions in ^{58}Ni, ^{60}Ni and ^{62}Ni are summarized in Table 3. These processes were addressed in the present evaluation. In addition, there are possible contributions from the minority ($\lesssim$ 1% abundant) ^{61}Ni and ^{64}Ni isotopes. Generally, the latter two isotopes were not given consideration. The primary intent was an elemental evaluated file. However, certain of the above processes are commonly employed on an isotopic basis particularly in dosimetry applications. In these instances the present evaluation includes a secondary isotopic evaluated file in addition to the primary elemental file. Both files are given in the ENDF/B format.

Subsequent sections deal with the specific (n;X) reactions in Table 3.

A. The (n;2n') Reaction

The present evaluation considered contributions from the ^{58}Ni(n;2n) and ^{60}Ni(n;2n) reactions as defined in the subsequent paragraphs. Both of these reactions have relatively higher thresholds than those associated with the few-percent-abundant ^{61}Ni, ^{62}Ni and ^{64}Ni. Therefore, in addition to the major contributions, the evaluation introduces a very small "tail" extending to the lowest threshold; 7.954 MeV (^{61}Ni). The neutron emission spectrum is approximated by a temperature distribution of the form $N(E) \sim E \cdot \exp(-E/T)$ where the energy dependence of the temperature is given by $T = 0.25 \sqrt{E+Q}$. This is a qualitative estimate based upon systematics and represents a somewhat different spectrum than given in ENDF/B-IV.

The isotopic and elemental evaluations are compared with those of ENDF/B-IV in Fig. 14. Over much of the energy range the present evaluation is $\tilde{\sim}$ 15% lower than that of ENDF/B-IV. This is probably not a significant difference. The uncertainties in both evaluations are at least as large as this difference due to the very uncertain knowledge of the ^{60}Ni(n;2n) process (see below).

The ^{58}Ni(n;2n')^{57}Ni Reaction

This reaction has a Q = -12.203 MeV. ^{57}Ni has a half life of 36 hours and decays via electron capture and β+ emission (73). Most reported measurements have involved counting annihilation gammas and there are no particular problems associated with measurement of the reaction cross section via this technique.

Measurements have been made over the entire range from threshold to 20 MeV with a concentration of values in the range 14-15 MeV. There are obvious discrepancies in several of the data sets. The available data were divided into two categories. One included those sets which appeared reasonably consistent in magnitude and in the energy dependence of the excitation function. In this category are included the data of Prestwood and Bayhurst (74), Paulsen and Liskien (75), Borman et al. (76), Glover and Weigold (77), Rayburn (78), Cross et al. (79), Bramlitt and Fink (80), Barrall et al. (81), Fink and Wen-deh-lu (82), Paul and Clarke (83), Strain and Ross (84) and Temperly (85). The second category consisted of data sets which were examined but rejected because of apparent inconsistencies with data in the first category. Selection and rejection of data sets were subjective and based on consideration of normalization, energy dependence and experimental factors which govern credibility. Included in the second category were the data of Rayburn (86), Jeronymo et al. (87), Preiss and Fink (88), Purser and Titterton (89), Csikai (90) and Csikai and Peto (91). Three data sets (Refs. 74-76) cover essentially the entire range from threshold to 20 MeV. The data of Prestwood and Bayhurst (74) appear consistently high while that of Borman et al. (76) are consistently low when compared with the data of Paulsen and Liskien (75). The data of Paulsen and Liskien was the most influential in this evaluation. The present evaluation is compared with the category one data base in Fig. 15.

The $^{60}Ni(n;2n')$ Reaction

There is apparently no experimental data available on this reaction. Estimates at 14 MeV based on statistical theory, N-Z systematics, empirical formulae and data from neighboring nuclei are often used and three evaluations of this sort have been reported. L. Jeki (92) gives a value of 359 mb. and Body and Csikai (93) reported a value of 408 mb. at 14 MeV. Pearlstein (94) computed $\sigma_{n,2n'}$ at three energies and for a fission neutron spectrum with the following results:

E_n (eV)	$\sigma_{n,2n}$ (mb)
13.1	156
14.1	295
15.1	409
fission spect.	0.034

We use the values of Pearlstein for 13.1, 14.1 and 15.1 MeV, then assume that $\sigma_{n,2n'}$ = 600 mb at 20 MeV. The qualitative rational for this choice is that the (n;2n') cross section for ^{58}Ni is ∿ 50% larger at 20 MeV than at 15 MeV and the Q-values differ by only ∿ 0.8 MeV.

B. The (n;3n') Reaction

All of the contributing reaction Q-values are negative and of large magnitude (the smallest is ^{64}Ni = -16.501 MeV). Moreover, the reaction thresholds for the prominent isotopes ^{58}Ni and ^{60}Ni are above 20.0 MeV. Therefore this process was not incorporated in the present evaluation.

C. The (n;p) Reaction

The present evaluation constructs the elemental (n;p) cross section from the ^{58}Ni(n;p), ^{60}Ni(n;p) and ^{61}Ni(n;p) components. Two possible additional contributions are the ^{62}Ni(n;p) and ^{64}Ni(n;p) components. Both of the latter were ignored due to small isotopic abundance and lack of experimental data. These omissions should have only a small effect upon the elemental cross sections. The derivation of the isotopic components is discussed in detail in the subsequent paragraphs. The results are graphically summarized and compared with ENDF/B-IV in Fig. 16. The present elemental evaluation is slightly larger than that of ENDF/B-IV ($\tilde{\sim}$ 5%) and does not show as much structure. The uncertainty associated with the evaluation is estimated to be $\lesssim$ 10% or 20 mb, whichever is larger, to energies of 14 MeV. The

The agreement with the prior ENDF/B-IV values is generally consistent with this accuracy estimate excepting those regions where ENDF/B-IV shows considerable structure (see discussion below).

The $^{58}Ni(n,p)^{58}Co$ Reaction

The Q-value of this reaction is +0.395 MeV. Various levels in ^{58}Co are populated. The most commonly discussed of these is the 9.15 hour isomeric state at 0.0249 keV and the ground state which decays via β+ emission and electron capture to levels in ^{58}Fe up to an excitation of 1.67 MeV (95). The reaction is well suited to study via activation techniques. The evaluation is inclusive of contributions from isomeric and ground states.

This reaction is widely employed in reactor dosimetry (96,97) because of the low "effective" threshold and because of the convenience of gamma counting. Consequently, there is not only a wealth of experimental data available, but also a number of evaluations (e.g., Refs. 96-99). The present evaluation gave primary attention to the experimental values. Because of the volume of data available, it was decided to be more selective than might otherwise be the case. The data selected met the criteria of being reasonably consistent with the average of all data sets. Greater weight was given to data sets which covered a wide energy range and exhibited reasonable energy dependence. The compilation of Liskien and Paulsen was utilized to deduce the general shape of the cross section between 1 and 20 MeV (100). This compilation includes most work through 1967. Between 1967 and the present, there have been several measurements as reported in CINDA (101). The two most significant new data sets are from the work of Paulsen and Widera (99) and from Smith and Meadows (102).

The data sets which most strongly influenced the present evaluation are plotted in Figs. 17 and 18. They are those of Smith and Meadows (102), Paulsen and Widera (99), Meadows and Whalen (103), Debertin and Roesle(104) and Barry (105). Other data sets were either rejected because they deviated too far from the average or were given less weight because they provided no new information or were in marginal agreement with the majority of previous values. This was particularly true for data in the 14-15 MeV region where an inclusion of all available data would not substantially contribute to the evaluation. These omissions were judged to have little effect on the evaluation. A curve was constructed through the selected data sets and the evaluated cross sections were derived from the curve.

For $E_n < 1$ MeV, only the data from Smith and Meadows (102) and from integral reactor measurements shed light on the cross section. The integral data has been distilled and evaluated by McElroy and co-workers (96,97) and leads to $\sim 3 \times 10^{-6}$ barn for $E_n \sim 0.5$ MeV. The integral measurements give no details of the excitation function. McElroy and co-workers have assumed that the $^{58}Ni(n;p)^{58}Co$ cross section is a constant fraction of the total cross section in this region. The data of Smith and Meadows extends down to 0.44 MeV. The two lowest energy points at 0.44 and 0.63 MeV have broad resolution and large errors. However, these data are consistent with an average cross section of $\sim 2.8 \times 10^{-6}$ barn. This is in good agreement with the general trend of the McElroy et al. results in this region so we assume that the cross section is approximately a constant of 2.8×10^{-6} barn for E_n = 0.1-.65 MeV. There may be structure in this region but there is not enough information available to determine its nature. From 0.65 MeV to 1 MeV, a smooth curve was drawn through the data of Smith and Meadows. This data indicates a lower "effective" threshold than previously assumed (e.g., see Refs. 96,97).

In the region E_n = 1.0-6.0 MeV, the evaluation was primarily influenced by the data of Paulsen and Widera (99), Smith and Meadows (102), Meadows and Whalen (103) and Barry (105). The data of Temperly in the region 3-3.5 MeV is in reasonable agreement with the primary set in overall magnitude, but does not exhibit a similar energy dependence (85). The same can be said for the data of Gonzalez et al. (106) and Van Loef (107). The data of Nakai et al. is consistent with the primary set, but is of poor resolution and has large errors (108). The data of Konijn and Lauber (109) deserves particular attention because of the influence it apparently had on the evaluation by Bresesti et al. (98) and the ENDF/B-IV evaluation. These data exhibit large fluctuations in the region 2.8-3.8 MeV while the average energy dependence is in reasonable agreement with the present evaluation. Smith and Meadows (102) measured the cross section with better resolution and observed some structure but the fluctuations were not nearly as large as observed by Konijn and Lauber. This discrepancy remains unresolved. We have accepted the data of Smith and Meadows in preference to that of Konijn and Lauber in this evaluation.

From 6-8 MeV, the data of Paulsen and Widera (99), Barry (105), Debertin and Roesle (104) are in reasonable agreement and adequately define the cross section. The data of Barry seems consistently higher than that of Paulsen and Widera, but the results agree within the stated error limits. The region from 8-13 MeV is devoid of data, so we have estimated the shape of the cross section with a curve which interpolates in a smooth manner.

The magnitude of the cross section and its energy dependence in the region 13-16 MeV is based on the work of Paulsen and Widera (99) and Barry (105). We have taken cognizance of the multitude of data points in the vicinity of 14 MeV. Much of these data consists of single-energy measurements with large error bars. Unfortunately, there are discrepancies of as much as a factor of 10 between several of these data sets. The data of Temperly (85) provide six data points in this region which exhibit a reasonable energy dependence, but otherwise are systematically higher than the data of Paulsen and Widera and of Barry.

For the region 16-20 MeV, only the data of Borman et al. (110,111) and of Jeronymo et al. (87) are available. The data of Jeronymo et al. gives cross sections which appear far too small and were not considered in the evaluation. The data of Borman et al. are considerably higher than that of Paulsen and Widera (99) and Barry (105). We have employed the general energy dependence of the data of Borman et al. in this evaluation, but normalized to the results of Paulsen and Widera and of Barry.

The resultant evaluated curve and the data which most strongly influenced the present evaluation are shown in Figs. 17 and 18.

The $^{60}Ni(n;p)^{60}Co$ Reaction

The $^{60}Ni(n;p)$ reaction produces the active daughter ^{60}Co. The Q-value for this reaction is -2.040 MeV. There are two prominent activities in ^{60}Co. The ground state has a half life of 5.24 years and generates the 1.17 and 1.33 MeV gamma rays familiar to users of gamma-ray detectors. The 58.6 keV excited state of ^{60}Co is an isomer with $T_{1/2} = 10.35$ min. The isomer cross section ratio σ_m/σ_g is of interest in nuclear structure studies. For most applications (dosimetry, heating and damage) the total cross section is important. This can be measured by waiting for all isomeric activity to die and then measuring the 5.24 year ground state activity.

Measurements have been made of the isomer cross section ratio. Paulsen and Widera (99) obtained a value of 0.53 ± 0.07 barns at $E_n = 8.19$ MeV and 0.52 ± 0.06 barns at 14.0 MeV. A measurement by Prasad and Sarkar (121) yields a value of 0.025 ± 0.006 barns for the 10.35 min isomer excitation cross section at $E_n = 14.8$ MeV. Assuming an isomer ratio of ∿ 0.5 it would seem that this value is too small by more than a factor of two.

Measurements by Allan (116,120) and March and Morton (118) were made using photographic emulsions. The emulsion measurements for E_n ∿ 14 MeV indicate that protons from the (n;p) reaction correspond to a nuclear temperature of ∿ 1 MeV.

Experimental measurements define the cross section reasonably well in the energy region $E_n = 5.6$-19 MeV. At lower energies ($E_n = 2$-5.6 MeV), there is a conspicuous absence of microscopic data.

We have relied on the evaluation of Simon and McElroy for $E_n = 2$-7 MeV (97). The lower-energy cross sections were deduced by unfolding activation data from various reactor spectra. Their evaluation agrees well with some of the microscopic data available at $E_n = 5.67$ MeV. Data from Liskien and Paulsen (112,113,114,115) cover the energy range $E_n = 5.6$-19 MeV quite thoroughly. We have relied heavily on these data since no other measurements cover as wide an energy range. The available data base indicated an "S-shape" structure in the region 10-12 MeV. No physical justification for such a "bump-dip" could be identified, therefore, the present evaluation assumes a smooth energy dependence rather similar to the maximum in the $^{58}Ni(n,p)^{58}Co$ reaction. The maximum spread of the measured values from the evaluation in this region is $\lesssim$ 2 standard deviations. The usual array of $\sim$ 14 MeV single data points is available. The data from Allan (116), Levkovskij et al. (117), March and Morton (118) and Storey et al. (119) are in reasonable agreement with the work of Liskien and Paulsen. Measurements at $\sim$ 14 MeV by Allan (120) and Cross et al. (79) yielded values which appear too large.

The present evaluation is compared with prominent data sets in Fig. 19.

The $^{61}Ni(n;p)^{61}Co$ Reaction

This reaction produces ^{61}Co which has a 1.65-hour half life and emits β- and γ-rays. Measurements of this cross section should not be particularly forbidding except for the low abundance of ^{61}Ni in natural nickel. In any event, the experimental data are limited.

Van Loef (107) has measured the (n,p) cross section at 3.3 ± 0.2 MeV and obtained the value 3 ± 1.5 mb. There are various fission spectrum and pile measurements which were not used in this evaluation. The only remaining data are at $E_n \approx$ 14 MeV. All of these measurements are via activation. Blosser and Handley (122) report σ_{np} = 91 mb at 14 MeV. Cross et al. reported a value of 103 ± 10 mb at 14.5 MeV (79) and later at 14 MeV measured a value of 83 mb (123). Levkovskij et al. report a value of 98 ± 10 mb for E_n = 15 MeV (117). Valter et al. (124) report a value of 86 mb at 14 MeV. These data are insufficient to define the shape of the (n;p) excitation function. However, we note that the Q value of this reaction is -0.5 MeV and differs by only $\sim$ 0.9 MeV from the

Q-value for ^{58}Ni(n;p)^{58}Co. Neglecting matters such as competition from other decay channels, we constructed and "evaluated" cross section curve which is qualitatively like the ^{58}Ni(n;p) curve but normalized to pass through the Van Loef point at 3.3 MeV and the available 14 MeV data. We accepted the suggested value of 88 mb for 14 MeV given by Pai et al. (125) in generating this curve. The evaluated cross section is shown the curve in Fig. 20.

The ^{62}Ni(n;p)^{62}Co Reaction

The ^{62}Ni(n;p) reaction leads to ^{62}Co which has a 13.9 min. ground state half life. There is also a 1.51 min. isomer. The only available information on the (n;p) cross section is at $E_n \sim 14$ MeV where there are several measured values. The activation measurements are by Levkovskij et al. (117) (21 ± 3 mb at 14 MeV), Cross et al. (123,125) (24 ± 6 mb at 15 MeV and 39 mb at 14 MeV) and Valter et al. (124) (22 mb at 14 MeV). The measurements by J. E. Strain (84) (106 mb at 14 MeV) and Preiss and Fink (88) (2.0 ± 0.5 mb) for the 1.51 min. isomer and 3.3 ± 0.02 mb for the 13.9 min. ground state at 14.8 MeV) seem discrepant. We assume a total (n,p) cross section at 14 MeV which is an average of values from Refs. 117, 123,125, namely 26 mb, and reject the values from Refs. 84 and 88. For comparison, we have the theoretical value from Gardner and Rosenblum (126) of 39 mb at 14 MeV which is in reasonable agreement with our choice. Since the fragmentary evidence indicates this reaction is similar to that in other nickel isotopes and the natural abundance is small, the process was not considered in the evaluation.

D. The (n;α) Reaction

All isotopes of nickel can contribute to this process at energies of a few MeV. However, the experimental information is very fragmentary and apparently limited to ^{58}Ni, ^{60}Ni and ^{62}Ni. ^{62}Ni has a low elemental abundance and was ignored in the present evaluation shown in Fig. 21. The cross sections of the present evaluation are 25-50% smaller than those of ENDF-IV and approach threshold in a different manner. Moreover, the present evaluation may be too large if some of the theoretical-systematic estimates given below are correct. These are large discrepancies but can be expected in view of the marginal data base available to both evaluations. The uncertainties are disturbing in view of the wide use of high-nickel alloys in radiation environments giving rise to materials-damage problems.

The ^{58}Ni(n;α)^{55}Fe Reaction

This reaction has a Q-value of +2.89 MeV. The product nucleus, ^{55}Fe decays 100% by electron capture to the ground state of ^{55}Mn. There is insufficient energy available to reach any excited states of ^{55}Mn, consequently the 2.4 year half-life decay (73) produces only X-rays. The large positive Q-value and the relatively large number of accessible states in ^{55}Fe virtually insure that the reaction cross section will be significant and the resultant α-particle spectra complex. Therefore, accurate measurements of the reaction cross section, inclusive of all final states in ^{55}Fe are very difficult to make.

In principle, it should be possible to utilize activation and low-energy photon ($E_\gamma \sim 6.5$ keV) detection techniques to measure the electron capture X-rays. Apparently this has not been done. The limited available data for this reaction deal with direct detection of the alpha particles.

Weitman et al. have measured the yield of helium produced by irradiation of natural nickel samples (127). For a fission spectrum most of the helium production is due to the $^{58}Ni(n;\alpha)^{55}Fe$ reaction. Mass spectrographic techniques were used to detect the helium. The objective of the measurement was to study swelling effects. The authors calculated on "effective" microscopic cross section for E_n = 1 MeV of 4.8×10^{-3} barn. No errors are quoted for this result, but it must be kept in mind that this derived value is dependent upon the shape of the cross section excitation function in the region of the fission neutrons and this function is essentially unknown.

Several measurements have been made of the α spectra for 14-15 MeV neutron bombardment of ^{58}Ni. These measurements were not able to distinguish alpha particles from (n;n',α) and (n;p',α) reactions. Slinn and Robson measured the cross section for excitation of the ground state of ^{55}Fe and deduced the value 1.0 ± 0.3 mb at E_n = 15.7 MeV (128). Spira and Robson made similar but more detailed measurements at E_n = 14.6 MeV (129). They deduced a cross section of 1.4 ± 0.4 mb for excitation of the ground state of ^{55}Fe and 4.4 ± 1.0 mb for excitation of the 1.332 + 1.412 MeV excited states of ^{55}Fe. In addition, they estimate a cross section of 7.6 ± 2.0 mb for production of α particles with E_α > 14.5 MeV (corresponding roughly to the excitation of levels in ^{55}Fe up to 3 MeV). In this work, the contributions from higher-energy states were neglected as the authors were explicitly interested in the excitation of discrete low-lying levels in order to study certain aspects of nuclear structure theory. This limitation makes the data of little value for applications.

Seebeck and Borman have made direct-particle detection measurements on the $^{58}Ni(n;\alpha)^{55}Fe$ reaction at 14.0 MeV (130). Their apparatus was designed to have a greater sensitivity to low-energy alpha particles than the measurements described above. Various techniques were employed to discriminate against noise and to reject background. In addition, they measured the cross section for the $^{27}Al(n;\alpha)^{24}Na$ reaction and obtained a value of 0.119 ± 0.010 barn which agrees well with results from activation experiments. For the $^{58}Ni(n;\alpha)^{55}Fe$ reaction, they deduce a cross section of 0.113 ± 0.016 barn after correcting the data for the $^{58}Ni(n;n',\alpha)$ reaction.

The results described above more or less exhaust the available data on the reaction, so we turned to theory for guidance in generating an evaluated curve. Gardner and Yu-Wen Yu conducted a study on the basic trends in (n;α) reaction cross sections for Z = 6 - 30 nuclei (131). Statistical calculations were used to predict the relative (n;α) reaction cross sections for 14.5 MeV neutrons and an empirical equation was developed to predict the absolute cross sections. Comparison was made with measured values wherever possible. No data were available for the $^{58}Ni(n;\alpha)^{55}Fe$ reactions, but the value calculated by these authors is 0.256 barns at 14.5 MeV. Buetner et al. carried out statistical calculations for various threshold-reaction cross sections including the $^{58}Ni(n;\alpha)^{55}Fe$ reaction (132). The excitation function which they generated increases nearly linearly from approximately zero at $\sim$ 5.0 MeV to $\sim$ 0.37 barn at $\sim$ 14 MeV. Between 14-16 MeV the cross section levels off and begins to decrease. The shape of the excitation is similar to that of the $^{59}Co(n;\alpha)^{56}Mn$ reaction for which considerable data are available (100). Such qualitative comparisons are a last resort since they can be so readily influenced by other factors such as Q-value and behavior of other decay-channels from the compound nucleus. The available theoretical information may not be very convincing. However, one fact in common is that these calculations indicate a larger cross section than one deduces from the data of Seebeck and Borman (130).

In making the present evaluation, it was decided to rely on the available data, sparse as they are, in order to deduce the magnitude of the cross section. The data of Weitman et al. provide a point at $\approx$ 1 MeV (127). The cross section may be non-zero at lower energies and possibly even significant for thermal neutrons, but lacking data, we assumed that it decreases linearly to approximately zero below 1 MeV. At 14.0 MeV, we chose the value of 0.113 barn reported by Seebeck and Borman because the agreement of their results for $^{27}Al(n;\alpha)^{24}Na$ with activation values is convincing (130). The shape of the cross section at other energies was estimated by comparison with the results for the $^{59}Co(n;\alpha)^{56}Mn$ reaction, taking qualitatively into account the differences in Q-values (Q= +0.3 MeV for the latter reaction). The $^{58}Ni(n;\alpha)^{55}Fe$ cross section is assumed to reach a maximum in the vicinity of 12 MeV and to decrease at higher energies where the $^{58}Ni(n;2n)$ reaction competes strongly.

Our evaluation is in good agreement with a similar curve generated by Meyer (133) except below 2.0 where our results are biased toward larger values by the data of Weitman et al. (127). Meyer was guided by the statistical calculations of Eriksson (134) at E_n = 5 and 10 MeV in the generation of his evaluated curve. The results are compared with the meager experimental data in Fig. 22.

<u>The $^{60}Ni(n;\alpha)^{57}Fe$ and $(^{60}Ni(n;\alpha,n'+n',\alpha)^{56}Fe)$ Reactions</u>

There is only one experimental measurement available, that of Spira and Robson (129). They measured the 14 MeV cross section for the $(n;\alpha)$ reaction to the ground state of ^{57}Fe and obtained 4.3 ± 2 mb. Including α's with energy E_α > 14.5 MeV the cross section was raised to 5.6 ± 2 mb.

Lacking data, we resort to theory and are again faced with a confusing picture. Gardner and Yu (131) have used the statistical model to calculate the (n;α) cross section at 14.5 MeV. They obtain $\sigma_{n\alpha}$ = 90.8 mb. Buetner et al. (132) have performed similar calculations for the (n;α) and (n;n'α) reactions and obtained results rising from threshold to $\tilde{\sim}$ 80 mb at 14-16 MeV. This is reasonably consistent with the Gardner and Yu estimate. However, Schmidt (135) questions the normalization used in the calculations by Buetner et al. and suggests that the calculations may overestimate the cross sections by a fact of ∿ 7. If so, the estimates of Buetner et al. are similar to the single measured value of Spira and Robson (129). There obviously is a large uncertainty in these cross sections. This evaluation accepts the theoretical estimates of Refs. (131) and (132) as they appear to be more consistent with the magnitudes encountered in the ^{58}Ni(n;α) processes. The possible error of nearly an order of magnitude is emphasized. It may amount to as much as $\tilde{\sim}$ 20 mb at 14 MeV in the elemental cross section.

The ^{62}Ni(n;α)^{59}Fe Reaction

The daughter ^{59}Fe has a 44.6 day half life and two microscopic measurements have been reported. Levkovskij et al. (117) report a value of 17 ± 4 mb at 14.8 MeV while Yu and Gardner (136) report a value of 22 ± 3 mb at 14.1 MeV. Gardner and Yu (131) have also computed the (n;α) cross section at 14 MeV using a semi-empirical formula (prior to measurement) and obtain 20.6 mb in good agreement with experiment. The above indicates that, in view of the isotopic abundance, this cross section will make a negligible contribution to the evaluation and thus it was omitted.

E. <u>The (n;α,n') Reaction</u>

The lowest threshold for this reaction is 6.401 MeV (^{60}Ni). There is some very fragmentary information available as outlined in the discussion of (n;α) processes. The present evaluation includes a (n;α,n') component estimated from the ^{58}Ni component alone as illustrated in Fig. 23. The uncertainties in this estimate may be very large (50 to 100%). The neutron emission spectrum is assumed to be a soft "temperature" distribution of the form used for the (n;2n) process. There is no comparable ENDF/B-IV component.

F. <u>The (n;p,n') and (n;d) Reactions</u>

Thresholds for (n;n,p'+p,n') reactions are all high, above $\approx$ 8.0 MeV. The present evaluation is based entirely upon contributions from ^{58}Ni and ^{60}Ni,estimated as outlined in the subsequent sections. Contributions from the remaining isotopes should be small as the abundance is a few percent or less and the thresholds are generally above $\approx$ 10.0 MeV. The resulting isotopic and elemental evaluated cross sections are outlined and compared with that of ENDF/B-IV in Fig. 24. The present evaluation is much larger than that of ENDF/B-IV and it may still be too small as the very fragmentary information about the ^{60}Ni contribution may have resulted in a small estimate. Measurements which led to the present evaluation may have included erroneous (n;d) contributions. However, this would likely be a small perturbation. Both evaluations are uncertain by rather large amounts, but probably much less than the discrepancy between the present work and that of ENDF/B-IV. The neutron emission spectrum was assumed to be a soft "temperature" distribution of the form used for the (n;2n') process. This is only a very qualitative estimate and gives no consideration to the differences between spectra from the (n;n',p) and (n;p,n') processes.

Such distinctions are not warranted in view of the qualitative nature of the estimate.

The (n;d) reaction was estimated following a method analogous to that described above. It consisted of only ^{58}Ni and ^{60}Ni contributions. The available information is very marginal and the present evaluation, shown in Fig. 25, must be considered little more than qualitative. However, the cross sections are small and should have little effect for most applications. There is no comparable ENDF/B-IV (n;d) file.

<u>The ^{58}Ni(n;n',p+p,n')^{57}Co and ^{58}Ni(n;d)^{57}Co Reactions</u>

The ^{58}Ni(n;d)^{58}Co reaction has a Q-value of -5.962 MeV while the breakup reactions ^{58}Ni(n;n',p+p,n')^{57}Co have a higher Q-value of -8.177 MeV. Weak binding and barrier penetration considerations are responsible for the fact that deuteron emission does not compete strongly with breakup. In all instances, ^{57}Co is the final product nucleus. ^{57}Co decays with a half life of 272 days to ^{57}Fe via electron capture. Consequently, activation techniques can be utilized to measure the cross section $\sigma_{n;n',p+p,n'+d}$. The fraction due to deuteron emission cannot be distinguished from the breakup fraction by this method. There is a source of error in activation measurements if no correction is made for the ^{58}Ni(n;2n)^{57}Ni ($\epsilon,\beta+$)^{57}Co contributions. This correction is not hard to make.

The distinction between the ^{58}Ni(n;n',p)^{57}Co and ^{58}Ni(n;p,n')^{57}Co reaction is one of reaction dynamics and should really be looked upon as separate exit channels for decay of the compound nucleus ^{59}Ni. The difference in dynamics leads to differences in the neutron and proton energy spectra which may have important consequences in so far as applications are concerned. In the absence of measurements the decay fractions for these channels is determined by compound-nucleus calculations. A few calculations of this nature have been made for 14 MeV neutrons, but the results leave much to be desired.

We first consider the available data from activation studies. The results of Barrall et al. (81), Glover and Weigold (77), Fink and Lu (82), Temperly (85), Cross et al. (79), Cross and Clarke (137) and Bramlitt and Fink (80) are reasonably consistent. The activation data of Purser and Titterton (89) and Jeronymo et al. (87) yield cross sections which are much smaller. With the exception of the data of Jeronymo et al., the above measurements are all in the region 13-15 MeV.

There have been various measurements involving detection of the charged reaction products. Many of these utilized nuclear emulsion techniques. Without exception, the cross sections derived from these measurements are low. Included in this group is the work of Alvar (138), Allan (116,120), Kumabe and Fink (139) and Glover and Purser (140). The data point of Allan (116) was included in the evaluation because it came closest to the activation values. The rest were rejected. Statistical calculation of the (n,d) reaction on ^{58}Ni by Lu and Fink (141) indicates a cross section of 0.01 barn at E_n = 14.4 MeV. Debertin and Roesle measured the deuteron spectrum for this reaction at 22 MeV and deduced a cross section of 0.0235 ± 0.004 barn including contributions from transitions up to ∿ 8 MeV excitation in the final nucleus ^{57}Co (104). Statistical calculations by Buetner et al. (132) indicate a cross section of ∿ 0.006 barn for E_n = 14.1 MeV. This sparse experimental and theoretical evidence is sufficient to conclude that the (n;d) contribution is a small perturbation to the breakup components. Our evaluation is based mostly on qualitative estimates with the results shown in Fig. 26.

Since the (n;d) contribution is small, the activation data is essentially due to the (n;n,p+p,n') components. We selected a value of 0.55 barn at 14.5 MeV as being representative of the experimental data. The data set of Jeronymo et al. (87), while apparently discrepant in normalization, is the only one which covers the energy range 12-20 MeV. A curve was drawn through the data of Jeronymo et al. and then renormalized by a factor of 3.55 so that the curve would pass through the selected 14.5 MeV value of 0.55 barn. The shape of the excitation function near threshold remains a matter of speculation.

The statistical calculations of the (n;n',p) and (n;p,n') contributions by Lu and Fink yielded a value of 2.5 at 14 MeV for the ratio $\sigma_{n,n',p}/\sigma_{n,p,n'}$ (141). The behavior at other energies is unknown. However, the present evaluation approximates this spectrum with a single evaporation distribution following the procedures used for the (n;2n') reaction. In the absence of definitive experimental results this estimate must be considered qualitative. The above evaluation and respective data base are illustrated in Fig. 27.

The $^{60}Ni(n;d)^{59}Co$ and $^{60}Ni(n;n',p+p,n')^{59}Co$ Reactions

There is very little information available on these two reactions. Colli and Iori (142) measured the differential cross section for the (n;d) reaction at an angle of 140 deg. (28° opening angle) and E_n = 14 MeV. For the ground state transition they obtain $\frac{d\sigma}{d\Omega}$ = 1.9 (±10%)

mb/sr. The ground state group is strongest, but from the appearance of the deuteron spectrum, there are unresolved levels corresponding to excitations up to ~ 3 MeV. It is estimated that $\frac{d\sigma}{d\Omega}$ for $E_x \lesssim 3$ MeV ($E_d > 4$ MeV) is ~ 4 mb/sr. It is difficult to estimate the integrated cross section of the basis of the limited data. Assuming isotropy we obtain $\sigma_{n,d} \lesssim 50$ mb. There is evidence based on $^{56}Fe(n;d)^{55}Mn$ angular distribution measurements by Colli et al. (143) that the assumption of isotropy is poor since the distributions exhibit the characteristic forward peaking of the direct pickup mechanism. Thus, $\sigma_{nd} \sim 50$ mb is almost certainly an overestimate.

Data on the (n;n',p) reaction have been deduced by peeling off the (n;p) contribution from nuclear emulsion measurements. Chatterjee (144) reviewed the 14 MeV data on (n;p) and (n;p,x) reactions as of 1964. There are apparently no newer results. The values reported by Chatterjee are: $\sigma_{n,np} = 60 \pm 12$ mb (from Allan (120)), $\tilde{\sim}$ 68 mb (from March and Morton (118) and 59 ± 9 mb (from Allan (116)). There is also a 15° differential scattering value of $\frac{d\sigma}{d\Omega}_{n;n'p} \lesssim 25.9 \pm 5.2$ mb (from Colli (145)). Calculations by Buetner et al. (132) of the (n;n',p)cross section for $E_n = 14$-16 MeV show that it increases rapidly from 12 mb at 14 MeV to ~ 120 mb at 16 MeV. If this is true, then the experimental data must be very uncertain in this region.

With the above evidence, evaluation must be a speculative and qualitative. We assume a 14 MeV (n;d) cross section value of 30 mb and the shape of the same reaction in ^{58}Ni, adjusted to the correct threshold. We follow the same procedure for the (n;n',p+p,n') reaction using a 14 MeV normalization of 65 mb. These are rough estimates which may be in error by factors of 2 to 5. However, the effects on application are probably small as the cross sections are not large and the isotopic contribution is small.

G. (n;t) Reaction

The thresholds for this reaction in both the prominent isotopes are above 11.0 MeV. The cross sections should be smaller than those of the (n;d) reaction (already small). Essentially no experimental information is available. Therefore, this process was omitted in the present evaluation.

H. (n;2p) and (n;^{3}He) Reactions

Both of these processes have relatively low thresholds in ^{58}Ni($\sim$ 6.5 MeV). They are experimentally essentially unknown and are probably similar to the (n;d) cross section, (i.e., small). Therefore, they were also omitted.

I. (n;2p,n'), (n;p,2n') and (n;p,α) Reactions

The first two of these have thresholds of $\gtrsim$ 15.0 MeV. The lowest (n;p,α) threshold is $\sim$ 6.5 MeV. Little is known about any of these processes and the cross sections are expected to be small. Therefore, they are not included in the present evaluation.

J. Photon Production

The photon-production evaluated cross sections were a composite of three contributions: 1) from neutron capture, 2) from (n;n',γ) reactions, and 3) and from high (> 4.0 MeV) neutrons as per the following.

Photon Production from Neutron Capture

The spectrum of capture gamma-rays at thermal neutron energy was taken from Ref. 146. The spectrum was assumed not to vary with incident neutron energy. While this assumption is obviously incorrect, no better prescription is known. The gamma-ray multiplicity was assumed to vary with incident neutron energy according to the relationship:

$$M(E_n) = M(Th)*(E_n + Q)/Q \quad ,$$

where $M(E_n)$ is the multiplicity at incident energy E_n, $M(Th)$ is the multiplicity at thermal neutron energy and Q is the Q-value of the reaction.

Photon Production from the (n,n',γ) Reactions for $E_n < 4.$ MeV

As outlined in Section V.3.A, discrete excitation functions are given for $(n;n',\gamma)$ reactions for levels up to 3.628 MeV. Several of the "states" are mixtures or combinations of levels from ^{58}Ni and ^{60}Ni which could not be resolved experimentally. Direct measurements of photon production are reported in Refs. 147,148 and 149. Only Ref. 149 reports data for incident energies less than 4 MeV. The gamma-ray production cross sections from 1 to 4 MeV reported in Ref. 149 presented the data in .25 MeV bins from .75 to 2 MeV and in .5 MeV bins for photon energies $\geq$ 2 MeV. In order to conserve energy between the excitation functions for neutron inelastic scattering and photon production for incident energies less than 4 MeV, level schemes and branching ratios were adopted for ^{58}Ni and ^{60}Ni from data provided in Refs. 23 and 150. Because some levels could not be resolved experimentally the adopted level schemes and disintegration modes are somewhat artificial. The assumed structure data are presented in Figs. 28 and 29 which can be compared with Fig. 4. As a check against the experimental data, the total photon production cross section at the upper end of this energy range (i.e., 4 MeV) was compared with the measured values reported in Ref. 149. It was found that the line spectra obtained as described here agreed within experimental error with the measurement.

Photon Production Cross Sections and Spectra $4.0 \leq E_n \leq 20$ MeV

The experimental data reported in Refs. 147,148 and 149 are in substantial agreement where they overlap. Since Ref. 149 covered the entire energy range the values for the cross section and spectra are based on the data of that reference. Because of a low energy cut-off at 0.75 MeV, two lower groups were added from 0.25 to 0.5 MeV and from 0.5 to 0.75 MeV with a value of 0.13 barns for the first of these and 0.26 barns for the second.

Comparison with ENDF/B-IV MAT 1190

The main difference between this evaluation and that of MAT 1190 is in the energy range from 1 to 4 MeV incident neutron energy. The ENDF/B-IV data are based on Ref. 149 from 1 to 20 MeV while the data presented here are based on the same reference but from 4 to 20 MeV. The reconciliation of inelastic scattering functions and photon production data from 1 to 4 MeV described above was not done in the ENDF/B evaluation.

VI. CONCLUDING REMARK

The total neutron cross sections of elemental nickel were determined at intervals of a keV from 0.25 to 5.0 MeV. The experimental values confirm the energy-averaged magnitudes of previously reported high resolution measurements at lower energies and give new definition in the few-MeV range. The differential elastic neutron scattering cross sections of nickel were measured from a 300 keV to 4.0 MeV with sufficient resolution to portray intermediate fluctuating structure. The cross sections for the inelastic neutron excitation of eight states to energies of 2.8 MeV were determined for incident neutron energies up to 4.0 MeV. The experimental results were described reasonably well by an optical-statistical model including corrections for resonance width fluctuation and correlation effects in compound-nucleus processes. The latter correction factors were significant and the interpretation was limited by uncertainties in their calculation. Contributions due to direct collective excitations were estimated by calculation and found to be small. They could not be identified in the present experimental results obtained at energies of $\lesssim$ 4.0 MeV.

The present experimental and calculational results together with those reported in the literature, were used to construct a comprehensive evaluated neutronic file in the ENDFformat. This evaluated file extended from 0.1 to 20.0 MeV and was extrapolated to thermal energies using the values previously defined in ENDF/B-IV. The present evaluation and that of ENDF/B-IV are substantively different in certain areas.

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Table 1

Optical Model Parameters[a]

$V^{b} = 50.80$ MeV,	$R_{V}^{e} = 1.198$ F,	$A_{V} = 0.66$ F
$W^{c} = 9.25$ MeV,	$R_{W}^{e} = 1.204$ F	$A_{W} = 0.484$ F
$V_{so}^{d} = 8.0$ MeV		

a) These parameter values are identical to those of Ref. 20. Their use in the present work involves compound-nucleus corrections as described in the text.

b) Saxon form.

c) Sacon derivative form.

d) Thomas Spin - orbit form.

e) Radii are expressed in form $R = R_i \cdot A^{1/3}$.

Table 2

Excited "Levels" Contributing to Discrete Inelastic Neutron Excitation Cross Sections

Level	E_x (MeV)	E_{th} (MeV)
1	1.172	1.192
2	1.333	1.355
3	1.454	1.479
4	2.158	2.195
5	2.286	2.324
6	2.459	2.500
7	2.506	2.548
8	2.625	2.670
9	2.775	2.822
10	2.960	3.010
11	3.270	3.325
12	3.628	3.689

Table 3

Summary of (n;X) Reaction Thresholds (in MeV)

Reaction	^{58}Ni	^{60}Ni	^{62}Ni
(n;2n')	12.415	11.579	10.770
(n;3n')	22.862	20.731	18.717
(n;p)	0	2.074	4.511
(n;p,n')	8.319	9.692	11.302
(n;d)	6.056	7.430	9.041
(n;t)	11.265	11.703	11.580
(2;2p)	6.671	10.488	14.460
(n;^{3}He)	6.599	9.338	12.375
(n:α)	0	0	0.442
(n;α,n')	6.519	6.401	7.136
(n;2p,n)	14.451	17.186	2.022
(n;p,2n')	19.895	20.329	20.790
(n;p,α)	6.430	9.367	10.502

FIGURE CAPTIONS

Fig. 1 Total and elastic scattering cross sections of elemental nickel. The present experimental total cross sections are indicated by a solid curve (below 1.5 MeV) and circular data points (above 1.5 MeV). The angle-integrated elastic scattering cross sections are indicated by square data points. The dotted line indicates the evaluated total neutron cross section described in Sec. V of the text.
(Neg. No. 116-2359)

Fig. 2 Differential elastic scattering cross sections of elemental nickel. The present experimental results, averaged over 50 keV resolution increments, are indicated by circular data points. The curves indicate the results of fitting Legendre polynomial series to the measured values.
(Neg. No. 116-2360)

Fig. 3 Comparisons of selected differential elastic scattering cross sections of the present work with previously reported values and with the results of model calculations. The present experimental values are indicated by circular data points; those of Ref. 17 by $\square$, Ref. 18 by $\triangle$, Ref. 19 by $+$, Ref. 20 by $\times$, Ref. 21 by $\diamond$, Ref. 22 by $\leftarrow$, Ref. 24 by N and Ref. 26 by $|\!\times$. The indicated incident neutron energies are those of the present results (in MeV). Some of the previously reported values may differ in incident energy by 5-10 percent. The results of model calculations described in Sec. IV of the text are indicated by curves.
(Neg. No. 116-2470)

Fig. 4 Excited structure of ^{58}Ni, ^{60}Ni and ^{62}Ni. Previously reported values, as summarized in the Nuclear Data Sheets (23), are shown for each of the isotopes. The results of the present experiments are noted by the boxes at the right of the diagram where the width of the boxes qualitatively indicates the experimental energy definition.
(Neg. No. 116-2164)

Fig. 5 Inelastic neutron excitation cross sections of nickel. The corresponding excitation energies (in MeV) and contributing isotopes are noted. The present experimental results are indicated by solid data points. Other (n;n') and (n;n';γ) experimental results are referenced as follows: △ =21, + = 30, × =24, ◇ =28, ↑ =29, ⊼ =25, Z = 31 and Y = 26. The solid curve indicates the evaluation described in Sec. V. of the text. The results of statistical model calculations are noted by the dotted curves and, when inclusive of direct-reaction contributions, by dashed curves.
(Neg. No. 116-2705)

Fig. 6 Comparison of measured and calculated total neutron cross sections of nickel.
(Neg. No. 116-2706)

Fig. 7 Comparison of measured and calculated differential cross sections for the elastic scattering of 3.5 MeV neutrons from nickel. The measured values are indicated by data points. The calculated results are noted by curves obtained using the indicated values of the overlap parameter, Q.
(Neg. No. 116-2707)

Fig. 8 Comparison of the present evaluated nickel total neutron cross sections with those given in ENDF/B-IV.
(Neg. No. 116-2329)

Fig. 9 Comparison of the present evaluated elastic neutron scattering cross sections of nickel with those given in ENDF/B-IV.
(Neg. No. 116-2710)

Fig.10 Evaluated elastic scattering distributions normalized to a constant elastic scattering cross section of one barn.
(Neg. No. 116-2712)

Fig.11 Some comparisons of evaluated discrete inelastic neutron excitation cross sections. The present evaluation is indicated by solid curves and that of ENDF/B-IV by dashed lines.
(Neg. No. 116-2713)

Fig.12 Evaluated inelastic neutron scattering cross sections. The results of the present evaluation are indicated by solid curves. In addition the total inelastic cross section given

by ENDF/B-IV is noted.
(Neg. No. 116-2711)

Fig.13 Comparison of evaluated radiative capture cross sections of nickel.
(Neg. No. 116-2709)

Fig.14 Evaluated (n;2n') cross sections of nickel. The isotopic and "NAT" values are from the present work. The ENDF/B-IV values for the natural element are also indicated.
(Neg. No. 116-2704)

Fig.15 The (n;2n') cross sections of ^{58}Ni. The experimental values are from Refs. 75-84 and the smooth curve is the present isotopic evaluation.
(Neg. No. 116-2191)

Fig.16 Comparison of the present evaluated (n;p) cross sections with those given in ENDF/B-IV.
(Neg. No. 116-2703)

Fig.17 The (n;p) cross sections of ^{58}Ni below 6.0 MeV. The experimental values are discussed in Sec. V of the text and the curve indicates the present evaluation.
(Neg. No. 116-2190)

Fig.18 The (n;p) cross sections of ^{58}Ni over the entire energy range of the evaluation. The experimental points are discussed in Sec. V of the text. The curve indicates the present evaluated results.
(Neg. No. 116-2189)

Fig.19 The (n;p) cross sections of ^{60}Ni. The experimental results are discussed in Sec. V of the text. The curve is the present evaluation.
(Neg. No. 116-2393)

Fig.20 The (n;p) cross sections of ^{61}Ni. The notation is identical to that of Fig. 19.
(Neg. No. 116-2394)

Fig.21 Comparison of the present evaluated (n;α) cross sections with those given in ENDF/B-IV.
(Neg. No. 116-2702)

Fig.22 Measured and evaluated (n;α) cross section of ^{58}Ni.
(Neg. No. 116-2207)

Fig.23 Evaluated (n;n',α+α,n') cross sections of nickel.
(Neg. No. 116-2699)

Fig.24 Comparison of evaluated (n;n',p+p,n') cross sections of nickel.
(Neg. No. 116-2701)

Fig.25 Evaluated (n;d) cross sections of nickel.
(Neg. No. 116-2700)

Fig.26 Evaluated (n,d) cross sections of ^{58}Ni.
(Neg. No. 116-2209)

Fig.27 Measured and evaluated (n;n'p+p,n') cross sections of ^{58}Ni.
(Neg. No. 116-2208)

Fig.28 Level scheme of ^{58}Ni used in the gamma-ray production evaluation.
(Neg. No. 116-7516)

Fig.29 Level scheme of ^{60}Ni used in the gamma-ray production evaluation.
(Neg. No. 116-7517)

APPENDIX

NUMERICAL EVALUATED DATA FILE IN THE ENDF/B FORMAT

```
2.80000+ 4 5.81826+ 1          1            0            0          55   28 1451     1
      + 0 0.0     + 0          0            0           12           0   28 1451     2
28 NI, REFERENCE  ANL/NDM- 11, 1975,                                     28 1451     3
AUTHØRS, A. SMITH, J. WHALEN, P. GUENTHER, D. SMITH, R. HØWERTØN         28 1451     4
C  EVALUATIØN NEW FØR ALL ENERGIES ABØVE 0.1 MEV                          28 1451     5
C  BELØW 0.1 MEV EVALUATIØN USES ENDF/B- IV                              28 1451     6
C                                                                        28 1451     7
C                                                                        28 1451     8
C                                                                        28 1451     9
C                                                                        28 1451    10
C                                                                        28 1451    11
C                                                                        28 1451    12
C                                                                        28 1451    13
C                                                                        28 1451    14
                               1          451           69               28 1451    15
                               2          151           64               28 1451    16
                               3            1          845               28 1451    17
                               3            2          843               28 1451    18
                               3            4           22               28 1451    19
                               3           16           11               28 1451    20
                               3           22            6               28 1451    21
                               3           28            6               28 1451    22
                               3           51            7               28 1451    23
                               3           52           12               28 1451    24
                               3           53           12               28 1451    25
                               3           54            8               28 1451    26
                               3           55            8               28 1451    27
                               3           56            8               28 1451    28
                               3           57            8               28 1451    29
                               3           58            7               28 1451    30
                               3           59            8               28 1451    31
                               3           60            8               28 1451    32
                               3           61            7               28 1451    33
                               3           62            7               28 1451    34
                               3           91            8               28 1451    35
                               3          102          221               28 1451    36
                               3          103           37               28 1451    37
                               3          104            7               28 1451    38
                               3          107           14               28 1451    39
                               3          251           23               28 1451    40
                               3          252           23               28 1451    41
                               3          253           23               28 1451    42
                               4            2          197               28 1451    43
                               4           16           10               28 1451    44
                               4           22           10               28 1451    45
                               4           28           10               28 1451    46
                               4           51           37               28 1451    47
                               4           52           37               28 1451    48
                               4           53           37               28 1451    49
                               4           54           10               28 1451    50
                               4           55           10               28 1451    51
                               4           56           10               28 1451    52
                               4           57           10               28 1451    53
                               4           58           10               28 1451    54
                               4           59           10               28 1451    55
                               4           60           10               28 1451    56
                               4           61           10               28 1451    57
                               4           62           10               28 1451    58
                               4           91           10               28 1451    59
```

		5	16	9		28	1451	60
		5	22	8		28	1451	61
		5	28	8		28	1451	62
		5	91	173		28	1451	63
		12	102	4		28	1451	64
		13	3	117		28	1451	65
		14	3	1		28	1451	66
		14	102	1		28	1451	67
		15	3	59		28	1451	68
		15	102	33		28	1451	69
						28	1 0	70
0,00000+ 0	0,00000+ 0	0	0	0	0	28	0 0	71
2,80000+ 4	5,81826+ 1	0	0	4	0	28	2151	72
2,80580+ 4	6,80800- 1	0	0	1	0	28	2151	73
1,00000- 5	1,00000+ 5	1	1	0	0	28	2151	74
0,00000+ 0	7,50000- 1	0	0	2	0	28	2151	75
5,74371+ 1	0,00000+ 0	0	0	18	3	28	2151	76
-2,85000+ 4	5,00000- 1	1,18190+ 4	1,18170+ 4	2.14000+ 0	0,00000+ 0	28	2151	77
1,55000+ 4	5,00000- 1	1,40210+ 3	1,40000+ 3	2.14000+ 0	0,00000+ 0	28	2151	78
6,28000+ 4	5,00000- 1	3,30210+ 3	3,30000+ 3	2.14000+ 0	0.00000+ 0	28	2151	79
5,74371+ 1	0,00000+ 0	1	0	72	12	28	2151	80
6,89000+ 3	5,00000- 1	6,23000- 1	2,30000- 2	6.00000- 1	0,00000+ 0	28	2151	81
1,33000+ 4	1,50000+ 0	8,20000- 1	2,20000- 1	6.00000- 1	0,00000+ 0	28	2151	82
1,36000+ 4	1,50000+ 0	1,06000+ 0	4,60000- 1	6.00000- 1	0,00000+ 0	28	2151	83
1,90000+ 4	1,50000+ 0	6,33000- 1	3,30000- 2	6.00000- 1	0,00000+ 0	28	2151	84
2,00000+ 4	1,50000+ 0	7,20000- 1	1,20000- 1	6,00000- 1	0,00000+ 0	28	2151	85
2,11000+ 4	5,00000- 1	9,00000+ 0	8,40000+ 0	6.00000- 1	0,00000+ 0	28	2151	86
2,66000+ 4	1,50000+ 0	1,44000+ 0	8,40000- 1	6,00000- 1	0,00000+ 0	28	2151	87
3,24000+ 4	1,50000+ 0	3,57000+ 0	2,57000+ 0	1.00000+ 0	0,00000+ 0	28	2151	88
3,42000+ 4	1,50000+ 0	1,31000+ 0	7,10000- 1	6,00000- 1	0,00000+ 0	28	2151	89
3,61000+ 4	1,50000+ 0	2,03000+ 0	1,43000+ 0	6.00000- 1	0,00000+ 0	28	2151	90
4,79000+ 4	1,50000+ 0	4,76000+ 0	3,76000+ 0	1,00000+ 0	0,00000+ 0	28	2151	91
5,48000+ 4	5,00000- 1	1,29000+ 0	6,90000- 1	6.00000- 1	0,00000+ 0	28	2151	92
2,80600+ 4	2,64700- 1	0	0	1	0	28	2151	93
1,00000- 5	1,00000+ 5	1	1	0	0	28	2151	94
0,00000+ 0	6,50000- 1	0	0	2	0	28	2151	95
5,94154+ 1	0,00000+ 0	0	0	36	6	28	2151	96
1,24300+ 4	5,00000- 1	2,50210+ 3	2,50000+ 3	2.14000+ 0	0,00000+ 0	28	2151	97
2,87000+ 4	5,00000- 1	6,52140+ 2	6,50000+ 2	2.14000+ 0	0,00000+ 0	28	2151	98
4,30800+ 4	5,00000- 1	7,91400+ 1	7,70000+ 1	2.14000+ 0	0,00000+ 0	28	2151	99
6,53000+ 4	5,00000- 1	3,92430+ 2	3,90000+ 2	2,43000+ 0	0,00000+ 0	28	2151	100
8,70000+ 4	5,00000- 1	3,12140+ 2	3,10000+ 2	2,14000+ 0	0,00000+ 0	28	2151	101
9,66000+ 4	5,00000- 1	6,92140+ 2	6,90000+ 2	2.14000+ 0	0,00000+ 0	28	2151	102
5,94154+ 1	0,00000+ 0	1	0	84	14	28	2151	103
1,29200+ 3	5,00000- 1	6,01000- 1	1,00000- 3	6.00000- 1	0,00000+ 0	28	2151	104
2,25700+ 3	1,50000+ 0	6,34000- 1	3,40000- 2	6.00000- 1	0,00000+ 0	28	2151	105
5,53000+ 3	1,50000+ 0	6,28000- 1	2,80000- 2	6.00000- 1	0,00000+ 0	28	2151	106
2,38000+ 4	1,50000+ 0	1,90000+ 0	7,00000- 1	1.20000+ 0	0,00000+ 0	28	2151	107
3,01000+ 4	1,50000+ 0	8,20000- 1	2,20000- 1	6.00000- 1	0,00000+ 0	28	2151	108
3,29000+ 4	1,50000+ 0	8,40000- 1	2,40000- 1	6,00000- 1	0,00000+ 0	28	2151	109
3,33000+ 4	5,00000- 1	9,00000- 1	3,00000- 1	6,00000- 1	0,00000+ 0	28	2151	110
3,94000+ 4	1,50000+ 0	1,27000+ 0	2,70000- 1	1,00000+ 0	0,00000+ 0	28	2151	111
4,74000+ 4	1,50000+ 0	1,90000+ 0	7,00000- 1	1.20000+ 0	0.00000+ 0	28	2151	112
4,96000+ 4	5,00000- 1	1,05000+ 0	4,50000- 1	6,00000- 1	0,00000+ 0	28	2151	113
5,15000+ 4	1,50000+ 0	9,60000- 1	3,60000- 1	6,00000- 1	0,00000+ 0	28	2151	114
5,63000+ 4	5,00000- 1	1,66000+ 0	1,06000+ 0	6,00000- 1	0,00000+ 0	28	2151	115
5,69000+ 4	1,50000+ 0	9,20000- 1	3,20000- 1	6.00000- 1	0,00000+ 0	28	2151	116
7,13000+ 4	1,50000+ 0	8,90000- 1	2,90000- 1	6.00000- 1	0.00000+ 0	28	2151	117
2,80620+ 4	3,97000- 2	0	0	1	0	28	2151	118
1,00000- 5	1,00000+ 5	1	1	0	0	28	2151	119

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 0.00000+ 0 6.50000- 1          0          0          2          0 28 2151  120
 6.13958+ 1 0.00000+ 0          0          0         24          4 28 2151  121
 4.60000+ 3 5.00000- 1 1.70210+ 3 1.70000+ 3 2.14000+ 0 0.00000+ 0 28 2151  122
 3.85000+ 4 5.00000- 1 2.52140+ 2 2.50000+ 2 2.14000+ 0 0.00000+ 0 28 2151  123
 5.38000+ 4 5.00000- 1 1.02140+ 2 1.00000+ 2 2.14000+ 0 0.00000+ 0 28 2151  124
 9.35000+ 4 5.00000- 1 2.25210+ 3 2.25000+ 3 2.14000+ 0 0.00000+ 0 28 2151  125
 6.13958+ 1 0.00000+ 0          1          0          6          1 28 2151  126
 7.60000+ 4 5.00000- 1 1.75600+ 2 1.75000+ 2 6.00000- 1 0.00000+ 0 28 2151  127
 2.80640+ 4 1.48000- 2          0          0          1          0 28 2151  128
 1.00000- 5 1.00000+ 5          1          1          0          0 28 2151  129
 0.00000+ 0 7.50000- 1          0          0          2          0 28 2151  130
 6.33782+ 1 0.00000+ 0          0          0         12          2 28 2151  131
 1.38000+ 4 5.00000- 1 8.02140+ 2 8.00000+ 2 2.14000+ 0 0.00000+ 0 28 2151  132
 3.32000+ 4 5.00000- 1 9.52140+ 2 9.50000+ 2 2.14000+ 0 0.00000+ 0 28 2151  133
 6.33782+ 1 0.00000+ 0          1          0          6          1 28 2151  134
 9.52000+ 3 1.50000+ 0 7.18000+ 0 6.18000+ 0 1.00000+ 0 0.00000+ 0 28 2151  135
                                                                  28 2    0  136
 0.00000+ 0 0.00000+ 0          0          0          0          0 28 0    0  137
 2.80000+ 4 5.81826+ 1          0         99          0          0 28 3    1  138
 0.00000+ 0 0.00000+ 0          0          0          3       2526 28 3    1  139
          4          5         36          3       2526          2 28 3    1  140
 1.00000- 5 1.54136+ 2 1.00000- 4 5.40526+ 1 1.00000- 3 2.24026+ 1 28 3    1  141
 1.00000- 2 1.23943+ 1 2.53000- 2 1.06757+ 1 3.36743- 2 1.02879+ 1 28 3    1  142
 4.48205- 2 9.95200+ 0 5.96561- 2 9.66070+ 0 7.94022- 2 9.40820+ 0 28 3    1  143
 1.05684- 1 9.18930+ 0 1.40666- 1 8.99970+ 0 1.87226- 1 8.83510+ 0 28 3    1  144
 2.49198- 1 8.69263+ 0 3.31683- 1 8.56901+ 0 4.41470- 1 8.46184+ 0 28 3    1  145
 5.87596- 1 8.36884+ 0 7.82091- 1 8.28820+ 0 1.04096+ 0 8.21827+ 0 28 3    1  146
 1.38552+ 0 8.15744+ 0 1.84413+ 0 8.10475+ 0 2.45454+ 0 8.05875+ 0 28 3    1  147
 3.26699+ 0 8.01859+ 0 4.34836+ 0 7.98347+ 0 5.78767+ 0 7.95240+ 0 28 3    1  148
 7.70338+ 0 7.92497+ 0 1.02532+ 1 7.90035+ 0 1.36470+ 1 7.87770+ 0 28 3    1  149
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 1.00991+ 2 7.71446+ 0 1.22199+ 2 7.69007+ 0 1.62648+ 2 7.64579+ 0 28 3    1  152
 2.16484+ 2 7.58965+ 0 2.88140+ 2 7.51756+ 0 3.83514+ 2 7.42403+ 0 28 3    1  153
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9,52001+ 3	-8,91390- 1	9,53692+ 3	-8,90280- 1	9,55652+ 3	-9,06040- 1	28	3	1	181
9,79790+ 3	-1,11070+ 0	1,00000+ 4	-1,27509+ 0	1,06447+ 4	-1,79950+ 0	28	3	1	182
1,07777+ 4	-1,89340+ 0	1,11636+ 4	-2,11620+ 0	1,15680+ 4	-2,25070+ 0	28	3	1	183
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1,33019+ 4	-3,64660+ 0	1,33028+ 4	-3,62920+ 0	1,33419+ 4	-3,62900+ 0	28	3	1	186
1,35963+ 4	-3,78810+ 0	1,35975+ 4	-3,77610+ 0	1,35983+ 4	-3,76960+ 0	28	3	1	187
1,35997+ 4	-3,64570+ 0	1,36012+ 4	-3,83700+ 0	1,36017+ 4	-3,65780+ 0	28	3	1	188
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1,46761+ 4	-4,35390+ 0	1,47904+ 4	-4,13470+ 0	1,50000+ 4	-3,24522+ 0	28	3	1	191
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2,65997+ 4	-5,51385- 1	2,66005+ 4	-6,96900- 1	2,66010+ 4	-8,44181- 1	28	3	1	222
2,66016+ 4	-9,91270- 1	2,66023+ 4	-9,13810- 1	2,66034+ 4	-8,86100- 1	28	3	1	223
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3,00997+ 4	5,51339- 1	3,01013+ 4	5,38370- 1	3,01019+ 4	5,33886- 1	28	3	1	232
3,01028+ 4	5,38680- 1	3,01061+ 4	5,40827- 1	3,01090+ 4	5,41715- 1	28	3	1	233
3,01132+ 4	5,41225- 1	3,08927+ 4	3,35265- 1	3,09557+ 4	3,20768- 1	28	3	1	234
3,16722+ 4	1,74380- 1	3,20174+ 4	1,12483- 1	3,21600+ 4	8,84870- 2	28	3	1	235
3,22175+ 4	7,95900- 2	3,22757+ 4	7,19950- 2	3,23154+ 4	6,92010- 2	28	3	1	236
3,23424+ 4	7,04070- 2	3,23608+ 4	7,60250- 2	3,23733+ 4	8,65760- 2	28	3	1	237
3,23818+ 4	1,03827- 1	3,23676+ 4	1,29427- 1	3,23916+ 4	1,63182- 1	28	3	1	238
3,23943+ 4	2,21820- 1	3,23961+ 4	2,80530- 1	3,23973+ 4	2,78230- 1	28	3	1	239

3,23983+ 4	3,27846- 1	3,23992+ 4	3,77400- 1	3.24000+ 4	8,11000- 2	28	3	1	240
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3,25242+ 4	1,32179- 2	3,25825+ 4	7,42400- 3	3,27181+ 4	-5,55400- 3	28	3	1	245
3,28720+ 4	-1,08340- 2	3,28801+ 4	-1,04350- 2	3,28864+ 4	-9,93400- 3	28	3	1	246
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3,39079+ 4	-1,83450- 2	3,41330+ 4	-2,30290- 2	3,41544+ 4	-2,22380- 2	28	3	1	258
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3,72174+ 4	-2,13741- 1	3,83724+ 4	-2,67363- 1	3,93935+ 4	-3,12053- 1	28	3	1	277
3,93956+ 4	-3,10105- 1	3,93970+ 4	-3,08456- 1	3,93980+ 4	-3,03087- 1	28	3	1	278
3,93985+ 4	-3,07544- 1	3,93991+ 4	-3,11980- 1	3,94002+ 4	-3,29390- 1	28	3	1	279
3,94014+ 4	-3,29450- 1	3,94020+ 4	-3,28365- 1	3,94030+ 4	-3,26547- 1	28	3	1	280
3,94044+ 4	-3,22881- 1	3,94205+ 4	-3,18773- 1	4,03842+ 4	-3,58975- 1	28	3	1	281
4,09283+ 4	-3,83541- 1	4,12680+ 4	-4,00140- 1	4,18037+ 4	-4,31214- 1	28	3	1	282
4,22112+ 4	-4,65714- 1	4,24886+ 4	-5,06636- 1	4,26774+ 4	-5,61349- 1	28	3	1	283
4,28060+ 4	-6,39408- 1	4,28935+ 4	-7,52534- 1	4,29530+ 4	-9,09455- 1	28	3	1	284
4,29936+ 4	-1,09813+ 0	4,30212+ 4	-1,25883+ 0	4,30399+ 4	-1,30418+ 0	28	3	1	285
4,30527+ 4	-1,22271+ 0	4,30614+ 4	-1,11133+ 0	4,30800+ 4	-9,51876- 1	28	3	1	286
4,30986+ 4	-8,89608- 1	4,31073+ 4	-7,73740- 1	4,31388+ 4	-3,70451- 1	28	3	1	287
4,31664+ 4	-2,43394- 1	4,32070+ 4	-2,12976- 1	4,32665+ 4	-2,38332- 1	28	3	1	288
4,33540+ 4	-2,82229- 1	4,34826+ 4	-3,26122- 1	4,36714+ 4	-3,64312- 1	28	3	1	289
4,39488+ 4	-3,96957- 1	4,43563+ 4	-4,26433- 1	4,49549+ 4	-4,55856- 1	28	3	1	290
4,60023+ 4	-4,94090- 1	4,73903+ 4	-5,25853- 1	4,73955+ 4	-5,17243- 1	28	3	1	291
4,73970+ 4	-5,10351- 1	4,73979+ 4	-4,96650- 1	4,73985+ 4	-5,00446- 1	28	3	1	292
4,73990+ 4	-5,04230- 1	4,73997+ 4	-5,34574- 1	4,74004+ 4	-5,40740- 1	28	3	1	293
4,74014+ 4	-5,83550- 1	4,74021+ 4	-5,59130- 1	4,74030+ 4	-5,57709- 1	28	3	1	294
4,74045+ 4	-5,51095- 1	4,74142+ 4	-5,39985- 1	4,74450+ 4	-5,36845- 1	28	3	1	295
4,77872+ 4	-5,34107- 1	4,78232+ 4	-5,28372- 1	4,78477+ 4	-5,19181- 1	28	3	1	296
4,78644+ 4	-5,05230- 1	4,78758+ 4	-4,84623- 1	4,78835+ 4	-4,54664- 1	28	3	1	297
4,78888+ 4	-4,11702- 1	4,78924+ 4	-3,50620- 1	4,78948+ 4	-2,81990- 1	28	3	1	298
4,78965+ 4	-2.12280- 1	4,78984+ 4	-1.97680- 1	4,78989+ 4	-1,91100- 1	28	3	1	299

4,79000+	4-5,14000-	1	4,79011+	4-7,21600-	1	4.79016+	4-8,37420-	1	28	3	1	300
4,79035+	4-8,41810-	1	4,79052+	4-7,95420-	1	4.79076+	4-7,35450-	1	28	3	1	301
4,79112+	4-6,86686-	1	4,79165+	4-6,46894-	1	4.79242+	4-6,17585-	1	28	3	1	302
4,79356+	4-5,97190-	1	4,79523+	4-5,83421-	1	4,79768+	4-5,74364-	1	28	3	1	303
4,80657+	4-5,65594-	1	4,81434+	4-5,64587-	1	4,95947+	4-5,89082-	1	28	3	1	304
4,95964+	4-5,85527-	1	4,95975+	4-5,82268-	1	4,95983+	4-5,78116-	1	28	3	1	305
4,95997+	4-5,81613-	1	4,96011+	4-6,20865-	1	4,96017+	4-6,21164-	1	28	3	1	306
4,96025+	4-6,13292-	1	4,96036+	4-6,07208-	1	4,96053+	4-6,04206-	1	28	3	1	307
4,96115+	4-6,00329-	1	4,96169+	4-5,99363-	1	5,14951+	4-5,88914-	1	28	3	1	308
5,14967+	4-5,85577-	1	5,14977+	4-5,81071-	1	5,14996+	4-5,65681-	1	28	3	1	309
5,15015+	4-6,22176-	1	5,15023+	4-6,15702-	1	5,15033+	4-6,09738-	1	28	3	1	310
5,15049+	4-6,05467-	1	5,15105+	4-6,00794-	1	5,15155+	4-5,99533-	1	28	3	1	311
5,30367+	4-5,84757-	1	5,34463+	4-5,74452-	1	5,35592+	4-5,66531-	1	28	3	1	312
5,36361+	4-5,55995-	1	5,37241+	4-5,33925-	1	5,37483+	4-5.31701-	1	28	3	1	313
5,37761+	4-5,45018-	1	5,38000+	4-5,56508-	1	5,38240+	4-5,59538-	1	28	3	1	314
5,38759+	4-5,94997-	1	5,39116+	4-6,03299-	1	5,47792+	4-5,80996-	1	28	3	1	315
5,47904+	4-5,71152-	1	5,47934+	4-5,62773-	1	5,47955+	4-5,50118-	1	28	3	1	316
5,47970+	4-5,33680-	1	5,47979+	4-5,10923-	1	5,47985+	4-4,81230-	1	28	3	1	317
5,47990+	4-4,51680-	1	5,47997+	4-5,04733-	1	5,48004+	4-7,87310-	1	28	3	1	318
5,48014+	4-6,85170-	1	5,48021+	4-6,65012-	1	5,48030+	4-6,44247-	1	28	3	1	319
5,48045+	4-6,26890-	1	5,48066+	4-6,15724-	1	5,48142+	4-6,01524-	1	28	3	1	320
5,48306+	4-5,94786-	1	5,50164+	4-5,88571-	1	5,62876+	4-5,74383-	1	28	3	1	321
5,62942+	4-5,65396-	1	5,62961+	4-5,58784-	1	5,62973+	4-5,50754-	1	28	3	1	322
5,62982+	4-5,43185-	1	5,62997+	4-5,57373-	1	5,63012+	4-6,47717-	1	28	3	1	323
5,63018+	4-6,30651-	1	5,63027+	4-6,17671-	1	5,63039+	4-6,07062-	1	28	3	1	324
5,63057+	4-5,99149-	1	5,63084+	4-5,94050-	1	5,63268+	4-5,85924-	1	28	3	1	325
5,68953+	4-5,72660-	1	5,68968+	4-5,68652-	1	5,68978+	4-5,63616-	1	28	3	1	326
5,68997+	4-5,68414-	1	5,69015+	4-6,00914-	1	5,69022+	4-5,97124-	1	28	3	1	327
5,69032+	4-5,91882-	1	5,69047+	4-5,88690-	1	5,69148+	4-5,83143-	1	28	3	1	328
5,91933+	4-5,68070-	1	5,99231+	4-5,53576-	1	6,03448+	4-5,37760-	1	28	3	1	329
6,11287+	4-4,80862-	1	6,16623+	4-4,14266-	1	6,20256+	4-3,61256-	1	28	3	1	330
6,23674+	4-3,15793-	1	6,28000+	4-2,72734-	1	6,33037+	4-2,29043-	1	28	3	1	331
6,39411+	4-1,68420-	1	6,43750+	4-1,22426-	1	6,46703+	4-7,24786-	2	28	3	1	332
6,48714+	4-1,42185-	2	6,50082+	4 3.63075-	2	6,51014+	4 5,26477-	2	28	3	1	333
6,52080+	4-4,01630-	3	6,52552+	4-4,26654-	2	6,53000+	4-5,69638-	2	28	3	1	334
6,53920+	4-6,69390-	2	6,54986+	4-1.70046-	1	6,55918+	4-2,47297-	1	28	3	1	335
6,57286+	4-2,99468-	1	6,59297+	4-3,19408-	1	6,62250+	4-3,21266-	1	28	3	1	336
6,73752+	4-3,18707-	1	6,80984+	4-3,21019-	1	7,05836+	4-3,26154-	1	28	3	1	337
7,12902+	4-3,21871-	1	7,12955+	4-3,17344-	1	7,12969+	4-3,13838-	1	28	3	1	338
7,12979+	4-3,07902-	1	7,12997+	4-3,14743-	1	7,13014+	4-3,49283-	1	28	3	1	339
7,13021+	4-3,42967-	1	7,13031+	4-3,38238-	1	7,13045+	4-3,34145-	1	28	3	1	340
7,13143+	4-3,28468-	1	7,16288+	4-3,25397-	1	7,53919+	4-3,08572-	1	28	3	1	341
7,58694+	4-2,98788-	1	7,59395+	4-3,00126-	1	7,59588+	4-3,02660-	1	28	3	1	342
7,60000+	4-3,10087-	1	7,60889+	4-3,16012-	1	7,70343+	4-3,03110-	1	28	3	1	343
7,95977+	4-2,79878-	1	7,97576+	4-2,78210-	1	8,20436+	4-2,48024-	1	28	3	1	344
8,32579+	4-2,24826-	1	8,38283+	4-2,10443-	1	8,54122+	4-1,36557-	1	28	3	1	345
8,57014+	4-1,07738-	1	8,59191+	4-7,68720-	2	8,62642+	4 6,21000-	3	28	3	1	346
8,64992+	4 1,19282-	1	8,66591+	4 2,55617-	1	8,67679+	4 3,77910-	1	28	3	1	347
8,68420+	4 4,29027-	1	8,68925+	4 3,96350-	1	8,69268+	4 3,30945-	1	28	3	1	348
8,70000+	4 2,23482-	1	8,70732+	4 2,16109-	1	8,71075+	4 1,42156-	1	28	3	1	349
8,72321+	4-1,86507-	1	8,73409+	4-3,03435-	1	8,74765+	4-3,38302-	1	28	3	1	350
8,75008+	4-3,39341-	1	8,77358+	4-3,25367-	1	8,80809+	4-2,91575-	1	28	3	1	351
8,85878+	4-2,51524-	1	8,87642+	4-2,39818-	1	8,94029+	4-2,01838-	1	28	3	1	352
9,04267+	4-1,42516-	1	9,10401+	4-1,02102-	1	9,18804+	4-4,05020-	2	28	3	1	353
9,20339+	4-3,01530-	2	9,27241+	4-1,20440-	2	9,29718+	4-2,38410-	2	28	3	1	354
9,34277+	4-4,16720-	2	9,35000+	4-3,97170-	2	9,40282+	4-2,07720-	2	28	3	1	355
9,42759+	4-3,93950-	2	9,50792+	4-1,28912-	1	9,51745+	4-1,34501-	1	28	3	1	356
9,59735+	4-1,35779-	1	9,59985+	4-1,34730-	1	9,65067+	4-1,00203-	1	28	3	1	357
9,69685+	4-4,28300-	2	9,74894+	4 7,52170-	2	9,75550+	4 9,68090-	2	28	3	1	358
9,78440+	4 2,19528-	1	9,80854+	4 3,53682-	1	9,82497+	4 4,19508-	1	28	3	1	359

9.83615+ 4	3.99957- 1	9.84377+ 4	3.42867- 1	9.86000+ 4	2.45053- 1	28	3	1	360
9.87623+ 4	2.53461- 1	9.88086+ 4	2.17998- 1	9.89503+ 4	3.48410- 2	28	3	1	361
9.90508+ 4	-8.82580- 2	9.91146+ 4	-1.49093- 1	9.93560+ 4	-2.75606- 1	28	3	1	362
9.95111+ 4	-3.05112- 1	9.97106+ 4	-3.16949- 1	1.00000+ 5	-3.00276- 1	28	3	1	363
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.10650E 06	.30700E 01	.10670E 06	.30580E 01	.10700E 06	.30400E 01	28	3	1	366
.10720E 06	.42790E 01	.10870E 06	.13572E 02	.10910E 06	.16050E 02	28	3	1	367
.11000E 06	.17300E 02	.11010E 06	.16080E 02	.11070E 06	.12827E 02	28	3	1	368
.11100E 06	.11200E 02	.11170E 06	.85400E 01	.11200E 06	.74000E 01	28	3	1	369
.11300E 06	.63800E 01	.11400E 06	.58000E 01	.11470E 06	.54850E 01	28	3	1	370
.11570E 06	.50350E 01	.11600E 06	.49000E 01	.11670E 06	.46025E 01	28	3	1	371
.11800E 06	.40500E 01	.12000E 06	.36000E 01	.12020E 06	.35480E 01	28	3	1	372
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.12320E 06	.32120E 01	.12400E 06	.37000E 01	.12420E 06	.39600E 01	28	3	1	374
.12500E 06	.50000E 01	.12520E 06	.54000E 01	.12550E 06	.60000E 01	28	3	1	375
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.13120E 06	.24600E 01	.13300E 06	.19500E 01	.13320E 06	.19500E 01	28	3	1	378
.13500E 06	.19500E 01	.13520E 06	.19920E 01	.13600E 06	.21600E 01	28	3	1	379
.13620E 06	.23240E 01	.13720E 06	.31440E 01	.13800E 06	.38000E 01	28	3	1	380
.13820E 06	.41000E 01	.13970E 06	.63500E 01	.14000E 06	.68000E 01	28	3	1	381
.14020E 06	.70020E 01	.14100E 06	.78100E 01	.14200E 06	.80000E 01	28	3	1	382
.14300E 06	.12600E 02	.14350E 06	.11600E 02	.14420E 06	.10480E 02	28	3	1	383
.14500E 06	.92000E 01	.14620E 06	.76400E 01	.14700E 06	.66000E 01	28	3	1	384
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.15300E 06	.30000E 01	.15320E 06	.28800E 01	.15400E 06	.24000E 01	28	3	1	386
.15500E 06	.22000E 01	.15600E 06	.32000E 01	.15670E 06	.55100E 01	28	3	1	387
.15700E 06	.65000E 01	.15800E 06	.87000E 01	.15870E 06	.92600E 01	28	3	1	388
.15900E 06	.95000E 01	.16000E 06	.94000E 01	.16070E 06	.89800E 01	28	3	1	389
.16200E 06	.82000E 01	.16270E 06	.77800E 01	.16400E 06	.70000E 01	28	3	1	390
.16570E 06	.61500E 01	.16600E 06	.60000E 01	.16770E 06	.53285E 01	28	3	1	391
.16800E 06	.52100E 01	.16900E 06	.52000E 01	.17000E 06	.54800E 01	28	3	1	392
.17100E 06	.57600E 01	.17200E 06	.56000E 01	.17500E 06	.47800E 01	28	3	1	393
.18000E 06	.36000E 01	.18300E 06	.43670E 01	.18380E 06	.27850E 01	28	3	1	394
.18440E 06	.44780E 01	.18650E 06	.32570E 01	.18740E 06	.47680E 01	28	3	1	395
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.19080E 06	.39520E 01	.19220E 06	.11600E 02	.19260E 06	.11770E 02	28	3	1	397
.19360E 06	.84840E 01	.19510E 06	.40450E 01	.19580E 06	.36060E 01	28	3	1	398
.19670E 06	.40870E 01	.19750E 06	.57060E 01	.19800E 06	.64660E 01	28	3	1	399
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.20650E 06	.94270E 01	.20730E 06	.13510E 02	.20800E 06	.97060E 01	28	3	1	402
.20970E 06	.10320E 02	.21000E 06	.10271E 02	.21160E 06	.10010E 02	28	3	1	403
.21480E 06	.77140E 01	.21560E 06	.83060E 01	.21600E 06	.89224E 01	28	3	1	404
.21650E 06	.96930E 01	.21750E 06	.70220E 01	.21950E 06	.56610E 01	28	3	1	405
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.22830E 06	.15190E 01	.23010E 06	.18420E 01	.23200E 06	.45134E 01	28	3	1	408
.23260E 06	.53570E 01	.23450E 06	.97480E 01	.23650E 06	.93880E 01	28	3	1	409
.24000E 06	.73409E 01	.24080E 06	.68730E 01	.24260E 06	.72850E 01	28	3	1	410
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.25470E 06	.38570E 01	.25500E 06	.41976E 01	.25620E 06	.55600E 01	28	3	1	413
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.25870E 06	.65670E 01	.26200E 06	.46970E 01	.26460E 06	.34120E 01	28	3	1	415
.26590E 06	.34010E 01	.26600E 06	.33394E 01	.26700E 06	.27230E 01	28	3	1	416
.26720E 06	.16790E 01	.26800E 06	.17050E 01	.26870E 06	.23200E 01	28	3	1	417
.26930E 06	.19690E 01	.27130E 06	.22980E 01	.27200E 06	.38993E 01	28	3	1	418
.27340E 06	.71020E 01	.27440E 06	.82640E 01	.27500E 06	.79165E 01	28	3	1	419

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.55310E 06	.30100E 01	.55370E 06	.40400E 01	.55410E 06	.48300E 01	28	3	1	501
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.65380E	06	.37900E	01	.65430E	06	.42700E	01	.65450E	06	.44700E	01	28	3	1	549
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.77600E 06	.41200E 01	.77640E 06	.38700E 01	.77700E 06	.34800E 01	28	3	1	602
.77800E 06	.33100E 01	.77900E 06	.30100E 01	.78030E 06	.29100E 01	28	3	1	603
.78100E 06	.27960E 01	.78300E 06	.24700E 01	.78430E 06	.27500E 01	28	3	1	604
.78530E 06	.33500E 01	.78600E 06	.35600E 01	.78670E 06	.34000E 01	28	3	1	605
.78740E 06	.32700E 01	.78940E 06	.35000E 01	.79040E 06	.43100E 01	28	3	1	606
.79140E 06	.47900E 01	.79210E 06	.47900E 01	.79380E 06	.35700E 01	28	3	1	607
.79480E 06	.30000E 01	.79650E 06	.21700E 01	.79720E 06	.21200E 01	28	3	1	608
.79830E 06	.23900E 01	.79960E 06	.38800E 01	.80000E 06	.42171E 01	28	3	1	609
.80030E 06	.44700E 01	.80070E 06	.46600E 01	.80140E 06	.41500E 01	28	3	1	610
.80240E 06	.37300E 01	.80450E 06	.35100E 01	.80620E 06	.34000E 01	28	3	1	611
.80690E 06	.34800E 01	.80830E 06	.35900E 01	.80900E 06	.38600E 01	28	3	1	612
.81010E 06	.35100E 01	.81120E 06	.34500E 01	.81190E 06	.32800E 01	28	3	1	613
.81290E 06	.34200E 01	.81400E 06	.35600E 01	.81500E 06	.25800E 01	28	3	1	614
.81650E 06	.19100E 01	.81790E 06	.12000E 01	.81860E 06	.13700E 01	28	3	1	615
.81930E 06	.16900E 01	.82040E 06	.24700E 01	.82110E 06	.32500E 01	28	3	1	616
.82180E 06	.37000E 01	.82260E 06	.39700E 01	.82440E 06	.40600E 01	28	3	1	617
.82500E 06	.37060E 01	.82540E 06	.34700E 01	.82620E 06	.31600E 01	28	3	1	618
.82760E 06	.37800E 01	.82870E 06	.43600E 01	.83020E 06	.44000E 01	28	3	1	619
.83200E 06	.42100E 01	.83270E 06	.37300E 01	.83350E 06	.38100E 01	28	3	1	620
.83490E 06	.37900E 01	.83600E 06	.33000E 01	.83710E 06	.37700E 01	28	3	1	621
.83790E 06	.40700E 01	.83860E 06	.35300E 01	.83940E 06	.28000E 01	28	3	1	622
.84050E 06	.31300E 01	.84120E 06	.35000E 01	.84200E 06	.35500E 01	28	3	1	623
.84230E 06	.33100E 01	.84350E 06	.29000E 01	.84530E 06	.36200E 01	28	3	1	624
.84610E 06	.33800E 01	.84720E 06	.37400E 01	.84830E 06	.45000E 01	28	3	1	625
.84870E 06	.46000E 01	.84910E 06	.44600E 01	.85000E 06	.33718E 01	28	3	1	626
.85020E 06	.31300E 01	.85170E 06	.29700E 01	.85360E 06	.30100E 01	28	3	1	627
.85440E 06	.33100E 01	.85480E 06	.33400E 01	.85560E 06	.31900E 01	28	3	1	628
.85630E 06	.27000E 01	.85790E 06	.23000E 01	.85940E 06	.19400E 01	28	3	1	629
.86130E 06	.19000E 01	.86320E 06	.16700E 01	.86400E 06	.19700E 01	28	3	1	630
.86480E 06	.24700E 01	.86600E 06	.31600E 01	.86640E 06	.32100E 01	28	3	1	631
.86750E 06	.23400E 01	.86790E 06	.22100E 01	.86870E 06	.22500E 01	28	3	1	632
.86950E 06	.25800E 01	.87060E 06	.31700E 01	.87300E 06	.32800E 01	28	3	1	633
.87340E 06	.30600E 01	.87420E 06	.31200E 01	.87540E 06	.32900E 01	28	3	1	634
.87770E 06	.33800E 01	.87850E 06	.28900E 01	.87900E 06	.27150E 01	28	3	1	635
.87930E 06	.26100E 01	.88090E 06	.24300E 01	.88170E 06	.20000E 01	28	3	1	636
.88210E 06	.18800E 01	.88250E 06	.21000E 01	.88290E 06	.24900E 01	28	3	1	637
.88370E 06	.34800E 01	.88410E 06	.35100E 01	.88530E 06	.28600E 01	28	3	1	638
.88610E 06	.27200E 01	.88650E 06	.27400E 01	.88740E 06	.29700E 01	28	3	1	639
.88820E 06	.34500E 01	.88900E 06	.43100E 01	.88980E 06	.50000E 01	28	3	1	640
.89020E 06	.50500E 01	.89140E 06	.42200E 01	.89180E 06	.39400E 01	28	3	1	641
.89300E 06	.41900E 01	.89380E 06	.38700E 01	.89470E 06	.36800E 01	28	3	1	642
.89630E 06	.37100E 01	.89670E 06	.35000E 01	.89750E 06	.32200E 01	28	3	1	643
.89830E 06	.34500E 01	.89960E 06	.38700E 01	.90000E 06	.41900E 01	28	3	1	644
.90080E 06	.45900E 01	.90160E 06	.50200E 01	.90250E 06	.47000E 01	28	3	1	645
.90330E 06	.40900E 01	.90450E 06	.39000E 01	.90540E 06	.39300E 01	28	3	1	646
.90660E 06	.41300E 01	.90750E 06	.39100E 01	.90910E 06	.40400E 01	28	3	1	647
.91040E 06	.38500E 01	.91210E 06	.35900E 01	.91370E 06	.34300E 01	28	3	1	648
.91540E 06	.32900E 01	.91670E 06	.35600E 01	.91760E 06	.35200E 01	28	3	1	649
.91970E 06	.29800E 01	.92050E 06	.33400E 01	.92180E 06	.32700E 01	28	3	1	650
.92350E 06	.37200E 01	.92440E 06	.38500E 01	.92520E 06	.35500E 01	28	3	1	651
.92610E 06	.28300E 01	.92740E 06	.23700E 01	.92900E 06	.19510E 01	28	3	1	652
.92950E 06	.18200E 01	.93080E 06	.26800E 01	.93210E 06	.36600E 01	28	3	1	653
.93260E 06	.39700E 01	.93350E 06	.38600E 01	.93480E 06	.35000E 01	28	3	1	654
.93650E 06	.35500E 01	.93760E 06	.36600E 01	.93830E 06	.37800E 01	28	3	1	655
.93910E 06	.35200E 01	.94000E 06	.29600E 01	.94130E 06	.26800E 01	28	3	1	656
.94270E 06	.33000E 01	.94350E 06	.36800E 01	.94490E 06	.34000E 01	28	3	1	657
.94580E 06	.34300E 01	.94750E 06	.30000E 01	.94980E 06	.24100E 01	28	3	1	658
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.95380E 06	.33200E 01	.95470E 06	.35000E 01	.95610E 06	.30500E 01	28	3	1	660
.95790E 06	.28500E 01	.95880E 06	.31200E 01	.95970E 06	.37400E 01	28	3	1	661
.96060E 06	.39400E 01	.96240E 06	.33400E 01	.96420E 06	.27300E 01	28	3	1	662
.96510E 06	.29100E 01	.96610E 06	.30200E 01	.96740E 06	.30500E 01	28	3	1	663
.96880E 06	.32400E 01	.97020E 06	.25900E 01	.97160E 06	.22700E 01	28	3	1	664
.97340E 06	.25600E 01	.97480E 06	.23900E 01	.97620E 06	.25600E 01	28	3	1	665
.97810E 06	.29100E 01	.97900E 06	.37700E 01	.98000E 06	.43700E 01	28	3	1	666
.98090E 06	.43500E 01	.98180E 06	.40800E 01	.98320E 06	.39300E 01	28	3	1	667
.98510E 06	.31500E 01	.98700E 06	.26000E 01	.98800E 06	.27700E 01	28	3	1	668
.98940E 06	.35000E 01	.99030E 06	.36300E 01	.99130E 06	.34700E 01	28	3	1	669
.99270E 06	.31500E 01	.99510E 06	.30200E 01	.99700E 06	.28500E 01	28	3	1	670
.99850E 06	.35400E 01	.99940E 06	.36900E 01	.99990E 06	.34400E 01	28	3	1	671
.10000E 07	.33500E 01	.10020E 07	.29700E 01	.10040E 07	.31600E 01	28	3	1	672
.10060E 07	.27200E 01	.10080E 07	.35000E 01	.10130E 07	.25100E 01	28	3	1	673
.10150E 07	.28300E 01	.10160E 07	.30900E 01	.10180E 07	.22000E 01	28	3	1	674
.10200E 07	.23900E 01	.10220E 07	.18100E 01	.10260E 07	.33900E 01	28	3	1	675
.10290E 07	.35600E 01	.10320E 07	.24300E 01	.10330E 07	.24200E 01	28	3	1	676
.10350E 07	.29400E 01	.10380E 07	.31400E 01	.10400E 07	.27467E 01	28	3	1	677
.10410E 07	.25500E 01	.10430E 07	.31500E 01	.10440E 07	.41600E 01	28	3	1	678
.10460E 07	.36600E 01	.10500E 07	.26500E 01	.10520E 07	.31500E 01	28	3	1	679
.10550E 07	.19200E 01	.10570E 07	.21900E 01	.10590E 07	.28600E 01	28	3	1	680
.10610E 07	.31800E 01	.10630E 07	.33900E 01	.10670E 07	.21300E 01	28	3	1	681
.10700E 07	.23500E 01	.10730E 07	.31200E 01	.10750E 07	.24600E 01	28	3	1	682
.10760E 07	.21300E 01	.10790E 07	.31800E 01	.10810E 07	.37200E 01	28	3	1	683
.10830E 07	.43000E 01	.10860E 07	.37600E 01	.10890E 07	.36300E 01	28	3	1	684
.10930E 07	.19500E 01	.10960E 07	.19600E 01	.10980E 07	.25700E 01	28	3	1	685
.11000E 07	.30233E 01	.11010E 07	.32500E 01	.11040E 07	.29100E 01	28	3	1	686
.11050E 07	.30583E 01	.11100E 07	.38000E 01	.11120E 07	.35900E 01	28	3	1	687
.11140E 07	.41100E 01	.11180E 07	.29200E 01	.11210E 07	.21600E 01	28	3	1	688
.11240E 07	.28400E 01	.11280E 07	.18600E 01	.11310E 07	.28100E 01	28	3	1	689
.11350E 07	.31400E 01	.11380E 07	.21700E 01	.11390E 07	.19800E 01	28	3	1	690
.11400E 07	.23700E 01	.11430E 07	.37600E 01	.11450E 07	.37000E 01	28	3	1	691
.11480E 07	.32800E 01	.11500E 07	.36500E 01	.11520E 07	.37700E 01	28	3	1	692
.11540E 07	.42900E 01	.11560E 07	.46100E 01	.11600E 07	.32200E 01	28	3	1	693
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.11820E 07	.25800E 01	.11860E 07	.30800E 01	.11890E 07	.31700E 01	28	3	1	697
.11920E 07	.30400E 01	.11940E 07	.33500E 01	.11970E 07	.25700E 01	28	3	1	698
.11990E 07	.26900E 01	.12000E 07	.27300E 01	.12020E 07	.29200E 01	28	3	1	699
.12050E 07	.30800E 01	.12080E 07	.28900E 01	.12100E 07	.33900E 01	28	3	1	700
.12120E 07	.38100E 01	.12130E 07	.39100E 01	.12150E 07	.34900E 01	28	3	1	701
.12170E 07	.27400E 01	.12190E 07	.33300E 01	.12210E 07	.42200E 01	28	3	1	702
.12220E 07	.43200E 01	.12240E 07	.38000E 01	.12260E 07	.42500E 01	28	3	1	703
.12270E 07	.46200E 01	.12280E 07	.45000E 01	.12290E 07	.39200E 01	28	3	1	704
.12300E 07	.31700E 01	.12320E 07	.25000E 01	.12340E 07	.26400E 01	28	3	1	705
.12350E 07	.31500E 01	.12360E 07	.39600E 01	.12370E 07	.42600E 01	28	3	1	706
.12380E 07	.42800E 01	.12390E 07	.39800E 01	.12410E 07	.33800E 01	28	3	1	707
.12430E 07	.26400E 01	.12450E 07	.28000E 01	.12470E 07	.30200E 01	28	3	1	708
.12490E 07	.30600E 01	.12510E 07	.35900E 01	.12520E 07	.37600E 01	28	3	1	709
.12540E 07	.32900E 01	.12580E 07	.34000E 01	.12600E 07	.32067E 01	28	3	1	710
.12610E 07	.31100E 01	.12630E 07	.35400E 01	.12650E 07	.37200E 01	28	3	1	711
.12670E 07	.33500E 01	.12690E 07	.28900E 01	.12700E 07	.26500E 01	28	3	1	712
.12720E 07	.33900E 01	.12740E 07	.39800E 01	.12760E 07	.37000E 01	28	3	1	713
.12770E 07	.31200E 01	.12780E 07	.27800E 01	.12800E 07	.35300E 01	28	3	1	714
.12810E 07	.39000E 01	.12840E 07	.38500E 01	.12850E 07	.37533E 01	28	3	1	715
.12870E 07	.35600E 01	.12890E 07	.43200E 01	.12910E 07	.48400E 01	28	3	1	716
.12930E 07	.50500E 01	.12950E 07	.46600E 01	.12960E 07	.40600E 01	28	3	1	717
.12990E 07	.30700E 01	.13000E 07	.33300E 01	.13020E 07	.35200E 01	28	3	1	718
.13050E 07	.34000E 01	.13080E 07	.33000E 01	.13110E 07	.34900E 01	28	3	1	719

.13140E 07	.37900E 01	.13160E 07	.43800E 01	.13190E 07	.44300E 01	28	3	1	720
.13210E 07	.35800E 01	.13230E 07	.31800E 01	.13260E 07	.37200E 01	28	3	1	721
.13280E 07	.35400E 01	.13290E 07	.35700E 01	.13300E 07	.39800E 01	28	3	1	722
.13320E 07	.42900E 01	.13350E 07	.34700E 01	.13380E 07	.32600E 01	28	3	1	723
.13390E 07	.32567E 01	.13400E 07	.32533E 01	.13410E 07	.32500E 01	28	3	1	724
.13440E 07	.40300E 01	.13450E 07	.42900E 01	.13470E 07	.42200E 01	28	3	1	725
.13490E 07	.46400E 01	.13530E 07	.44000E 01	.13550E 07	.37867E 01	28	3	1	726
.13560E 07	.34800E 01	.13590E 07	.28100E 01	.13600E 07	.27125E 01	28	3	1	727
.13630E 07	.24200E 01	.13650E 07	.22000E 01	.13670E 07	.25600E 01	28	3	1	728
.13690E 07	.33700E 01	.13700E 07	.38300E 01	.13720E 07	.35200E 01	28	3	1	729
.13740E 07	.38600E 01	.13750E 07	.39200E 01	.13780E 07	.36600E 01	28	3	1	730
.13810E 07	.37900E 01	.13840E 07	.36000E 01	.13860E 07	.28700E 01	28	3	1	731
.13880E 07	.28000E 01	.13890E 07	.31300E 01	.13910E 07	.33000E 01	28	3	1	732
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.14060E 07	.26200E 01	.14080E 07	.32000E 01	.14120E 07	.33100E 01	28	3	1	735
.14140E 07	.30500E 01	.14160E 07	.29900E 01	.14190E 07	.33000E 01	28	3	1	736
.14200E 07	.32200E 01	.14230E 07	.35900E 01	.14250E 07	.40200E 01	28	3	1	737
.14270E 07	.35000E 01	.14290E 07	.34000E 01	.14320E 07	.42200E 01	28	3	1	738
.14330E 07	.42100E 01	.14360E 07	.31800E 01	.14400E 07	.32800E 01	28	3	1	739
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.14500E 07	.36300E 01	.14520E 07	.35400E 01	.14550E 07	.32100E 01	28	3	1	741
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.14810E 07	.37600E 01	.14830E 07	.33100E 01	.14850E 07	.31000E 01	28	3	1	745
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.15000E 07	.40271E 01	.15010E 07	.41400E 01	.15040E 07	.37700E 01	28	3	1	747
.15070E 07	.31600E 01	.15100E 07	.25200E 01	.15110E 07	.25200E 01	28	3	1	748
.15160E 07	.36200E 01	.15170E 07	.37100E 01	.15260E 07	.28100E 01	28	3	1	749
.15290E 07	.32700E 01	.15320E 07	.32200E 01	.15380E 07	.28000E 01	28	3	1	750
.15420E 07	.27200E 01	.15460E 07	.34400E 01	.15480E 07	.38500E 01	28	3	1	751
.15490E 07	.38500E 01	.15500E 07	.35700E 01	.15520E 07	.30100E 01	28	3	1	752
.15560E 07	.28500E 01	.15580E 07	.31800E 01	.15600E 07	.36100E 01	28	3	1	753
.15620E 07	.34900E 01	.15640E 07	.31800E 01	.15660E 07	.32600E 01	28	3	1	754
.15690E 07	.35100E 01	.15730E 07	.30300E 01	.15770E 07	.32700E 01	28	3	1	755
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.15890E 07	.30600E 01	.15920E 07	.24500E 01	.15960E 07	.21400E 01	28	3	1	757
.15990E 07	.23700E 01	.16000E 07	.25200E 01	.16020E 07	.28000E 01	28	3	1	758
.16030E 07	.28300E 01	.16050E 07	.27000E 01	.16060E 07	.27800E 01	28	3	1	759
.16080E 07	.35300E 01	.16100E 07	.44300E 01	.16110E 07	.45300E 01	28	3	1	760
.16130E 07	.40000E 01	.16160E 07	.35900E 01	.16180E 07	.33900E 01	28	3	1	761
.16210E 07	.34600E 01	.16240E 07	.32700E 01	.16270E 07	.36000E 01	28	3	1	762
.16280E 07	.34600E 01	.16310E 07	.27700E 01	.16350E 07	.28500E 01	28	3	1	763
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.16450E 07	.31300E 01	.16460E 07	.31600E 01	.16480E 07	.30400E 01	28	3	1	765
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.16560E 07	.31100E 01	.16590E 07	.29800E 01	.16620E 07	.32700E 01	28	3	1	767
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.16710E 07	.37900E 01	.16720E 07	.37700E 01	.16750E 07	.35000E 01	28	3	1	769
.16760E 07	.35300E 01	.16800E 07	.29500E 01	.16830E 07	.30800E 01	28	3	1	770
.16870E 07	.32100E 01	.16890E 07	.30300E 01	.16930E 07	.25000E 01	28	3	1	771
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.17220E 07	.30500E 01	.17240E 07	.30300E 01	.17260E 07	.30800E 01	28	3	1	776
.17290E 07	.30100E 01	.17320E 07	.28400E 01	.17340E 07	.30400E 01	28	3	1	777
.17370E 07	.31900E 01	.17400E 07	.32700E 01	.17420E 07	.31100E 01	28	3	1	778
.17440E 07	.29100E 01	.17460E 07	.30100E 01	.17500E 07	.30200E 01	28	3	1	779

.17540E 07	.28000E 01	.17550E 07	.28200E 01	.17590E 07	.31600E 01	28	3	1	780
.17600E 07	.30500E 01	.17630E 07	.26300E 01	.17650E 07	.25200E 01	28	3	1	781
.17670E 07	.25500E 01	.17690E 07	.28400E 01	.17720E 07	.33000E 01	28	3	1	782
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.17900E 07	.31500E 01	.17930E 07	.39900E 01	.17950E 07	.43200E 01	28	3	1	785
.17980E 07	.44500E 01	.17990E 07	.43700E 01	.18000E 07	.42800E 01	28	3	1	786
.18020E 07	.39700E 01	.18050E 07	.39400E 01	.18080E 07	.41800E 01	28	3	1	787
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.18600E 07	.29400E 01	.18610E 07	.29200E 01	.18630E 07	.25200E 01	28	3	1	794
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.18780E 07	.24000E 01	.18820E 07	.28400E 01	.18840E 07	.31400E 01	28	3	1	796
.18870E 07	.33400E 01	.18880E 07	.33300E 01	.18910E 07	.31100E 01	28	3	1	797
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.19010E 07	.35600E 01	.19030E 07	.34200E 01	.19060E 07	.32500E 01	28	3	1	799
.19080E 07	.32700E 01	.19100E 07	.33600E 01	.19110E 07	.33600E 01	28	3	1	800
.19120E 07	.32200E 01	.19150E 07	.31000E 01	.19170E 07	.29300E 01	28	3	1	801
.19210E 07	.26700E 01	.19240E 07	.25900E 01	.19260E 07	.24700E 01	28	3	1	802
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.19460E 07	.33500E 01	.19470E 07	.32800E 01	.19490E 07	.31300E 01	28	3	1	805
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.19560E 07	.23000E 01	.19590E 07	.24900E 01	.19620E 07	.27000E 01	28	3	1	807
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.19710E 07	.30800E 01	.19740E 07	.32300E 01	.19760E 07	.34500E 01	28	3	1	809
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.19970E 07	.31100E 01	.19990E 07	.29800E 01	.20000E 07	.29950E 01	28	3	1	812
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.20340E 07	.38000E 01	.20400E 07	.34900E 01	.20450E 07	.32400E 01	28	3	1	816
.20520E 07	.29700E 01	.20550E 07	.31500E 01	.20590E 07	.34400E 01	28	3	1	817
.20610E 07	.34700E 01	.20670E 07	.32400E 01	.20720E 07	.29600E 01	28	3	1	818
.20740E 07	.28700E 01	.20780E 07	.30100E 01	.20830E 07	.29600E 01	28	3	1	819
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.20970E 07	.29100E 01	.21000E 07	.27950E 01	.21030E 07	.26800E 01	28	3	1	821
.21090E 07	.30400E 01	.21130E 07	.28500E 01	.21190E 07	.31000E 01	28	3	1	822
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.21360E 07	.34400E 01	.21400E 07	.37300E 01	.21450E 07	.34800E 01	28	3	1	824
.21480E 07	.36600E 01	.21520E 07	.29800E 01	.21560E 07	.26600E 01	28	3	1	825
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.21900E 07	.30400E 01	.21950E 07	.30900E 01	.21960E 07	.31000E 01	28	3	1	828
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.22080E 07	.31300E 01	.22160E 07	.27700E 01	.22200E 07	.26400E 01	28	3	1	830
.22290E 07	.34500E 01	.22320E 07	.34900E 01	.22370E 07	.30600E 01	28	3	1	831
.22410E 07	.29700E 01	.22490E 07	.32100E 01	.22500E 07	.31600E 01	28	3	1	832
.22550E 07	.29100E 01	.22580E 07	.31100E 01	.22650E 07	.34200E 01	28	3	1	833
.22730E 07	.33200E 01	.22820E 07	.28000E 01	.22880E 07	.33800E 01	28	3	1	834
.22900E 07	.34500E 01	.22930E 07	.32400E 01	.22980E 07	.34900E 01	28	3	1	835
.23000E 07	.33500E 01	.23030E 07	.31400E 01	.23070E 07	.34500E 01	28	3	1	836
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.23410E 07	.29600E 01	.23480E 07	.35400E 01	.23530E 07	.36000E 01	28	3	1	839

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.23780E	07	.27100E	01	.23810E	07	.29700E	01	.23870E	07	.32300E	01	28 3	1	841
.23920E	07	.30700E	01	.23940E	07	.31400E	01	.23970E	07	.36200E	01	28 3	1	842
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,34110E	07	,32900E	01	,34200E	07	,32200E	01	,34300E	07	,34900E	01	28	3	1	903
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,35500E	07	,35500E	01	,35560E	07	,34900E	01	,35660E	07	,36500E	01	28	3	1	909
,35750E	07	,35400E	01	,35850E	07	,34800E	01	,35950E	07	,36100E	01	28	3	1	910
,36000E	07	,35700E	01	,36050E	07	,35300E	01	,36150E	07	,34800E	01	28	3	1	911
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,36930E	07	,33400E	01	,37000E	07	,32770E	01	,37030E	07	,32500E	01	28	3	1	915
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,43270E	07	,35900E	01	,43360E	07	,37100E	01	,43620E	07	,35500E	01	28	3	1	933
,43850E	07	,36400E	01	,44000E	07	,35626E	01	,44160E	07	,34800E	01	28	3	1	934
,44430E	07	,35700E	01	,44610E	07	,38000E	01	,44750E	07	,36500E	01	28	3	1	935
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,49760E	07	,35900E	01	,49980E	07	,36300E	01	,50000E	07	,36420E	01	28	3	1	944
,50030E	07	,36600E	01	,50580E	07	,36200E	01	,50910E	07	,35900E	01	28	3	1	945
,51130E	07	,35700E	01	,51410E	07	,36000E	01	,51530E	07	,34800E	01	28	3	1	946
,51930E	07	,36500E	01	,52270E	07	,36500E	01	,52560E	07	,36300E	01	28	3	1	947
,52970E	07	,36100E	01	,53000E	07	,36150E	01	,53270E	07	,36600E	01	28	3	1	948
,53330E	07	,37000E	01	,53750E	07	,36000E	01	,54000E	07	,35931E	01	28	3	1	949
,54110E	07	,35900E	01	,54240E	07	,35000E	01	,54420E	07	,35300E	01	28	3	1	950
,54670E	07	,35200E	01	,54920E	07	,35900E	01	,55000E	07	,35544E	01	28	3	1	951
,55100E	07	,35100E	01	,55420E	07	,35400E	01	,55670E	07	,35800E	01	28	3	1	952
,55860E	07	,36800E	01	,56250E	07	,35600E	01	,56700E	07	,36100E	01	28	3	1	953
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,57630E	07	,35700E	01	,58000E	07	,36873E	01	,58040E	07	,37000E	01	28	3	1	955
,58380E	07	,36200E	01	,58720E	07	,36400E	01	,59000E	07	,36263E	01	28	3	1	956
,59130E	07	,36200E	01	,59270E	07	,36600E	01	,59630E	07	,35900E	01	28	3	1	957
,59980E	07	,36400E	01	,60000E	07	,36286E	01	,60050E	07	,36000E	01	28	3	1	958
,60560E	07	,36056E	01	,61000E	07	,36104E	01	,61870E	07	,36200E	01	28	3	1	959

,63000E 07	,36200E 01	,64000E 07	,36200E 01	,64010E 07	,36200E 01	28	3	1	960
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,78080E 07	,35100E 01	,79540E 07	,35100E 01	,79910E 07	,35100E 01	28	3	1	965
,80000E 07	,35098E 01	,81360E 07	,35060E 01	,83190E 07	,34585E 01	28	3	1	966
,84250E 07	,34310E 01	,85000E 07	,34251E 01	,87300E 07	,34070E 01	28	3	1	967
,90000E 07	,33684E 01	,90520E 07	,33610E 01	,93920E 07	,33110E 01	28	3	1	968
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,11900E 08	,29630E 01	,12000E 08	,29505E 01	,12250E 08	,29192E 01	28	3	1	973
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,15500E 08	,25597E 01	,15590E 08	,25520E 01	,16000E 08	,25226E 01	28	3	1	978
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,19100E 08	,23870E 01	,19500E 08	,23750E 01	,20000E 08	,23600E 01	28	3	1	982
,00000E 00	,00000E 00					28	3	0	983
2,80000+ 4	5,81826+ 1	0	0	0	0	28	3	2	984
0,0000E+00	0,0000E+00	0	0	2	2519	28	3	2	985
2	3	2519	2	0	0	28	3	2	986
1,00000- 5	7,76560+ 0	2,53000- 2	7,76560+ 0	3,36743- 2	7,76550+ 0	28	3	2	987
4,48205- 2	7,76560+ 0	5,96561- 2	7,76560+ 0	7,94022- 2	7,76560+ 0	28	3	2	988
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1,38552+ 0	7,76420+ 0	1,84413+ 0	7,76390+ 0	2,45454+ 0	7,76330+ 0	28	3	2	992
3,26699+ 0	7,76250+ 0	4,34836+ 0	7,76150+ 0	5,78767+ 0	7,76000+ 0	28	3	2	993
7,70338+ 0	7,75820+ 0	1,02532+ 1	7,75580+ 0	1,36470+ 1	7,75240+ 0	28	3	2	994
1,81642+ 1	7,74810+ 0	2,41765+ 1	7,74230+ 0	3,21789+ 1	7,73460+ 0	28	3	2	995
4,28302+ 1	7,72430+ 0	5,70070+ 1	7,71060+ 0	7,58763+ 1	7,69260+ 0	28	3	2	996
1,00991+ 2	7,66840+ 0	1,22199+ 2	7,64820+ 0	1,62648+ 2	7,60950+ 0	28	3	2	997
2,16484+ 2	7,55820+ 0	2,88140+ 2	7,49030+ 0	3,83514+ 2	7,40040+ 0	28	3	2	998
5,10458+ 2	7,28190+ 0	6,17654+ 2	7,18270+ 0	8,22097+ 2	6,99560+ 0	28	3	2	999
9,94738+ 2	6,84000+ 0	1,29104+ 3	6,57800+ 0	1,29134+ 3	6,57770+ 0	28	3	2	1000
1,29155+ 3	6,57750+ 0	1,29179+ 3	6,57730+ 0	1,29186+ 3	6,57720+ 0	28	3	2	1001
1,29201+ 3	6,57710+ 0	1,29214+ 3	6,57700+ 0	1,29230+ 3	6,57680+ 0	28	3	2	1002
1,29245+ 3	6,57670+ 0	1,29266+ 3	6,57650+ 0	1,29342+ 3	6,57590+ 0	28	3	2	1003
1,76224+ 3	6,17460+ 0	2,25226+ 3	5,77280+ 0	2,25378+ 3	5,77160+ 0	28	3	2	1004
2,25480+ 3	5,77090+ 0	2,25551+ 3	5,77060+ 0	2,25598+ 3	5,77030+ 0	28	3	2	1005
2,25631+ 3	5,77000+ 0	2,25653+ 3	5,76960+ 0	2,25668+ 3	5,77040+ 0	28	3	2	1006
2,25685+ 3	5,77020+ 0	2,25701+ 3	5,76750+ 0	2,25715+ 3	5,76760+ 0	28	3	2	1007
2,25732+ 3	5,76670+ 0	2,25747+ 3	5,76610+ 0	2,25769+ 3	5,76660+ 0	28	3	2	1008
2,25802+ 3	5,76700+ 0	2,25849+ 3	5,76690+ 0	2,25919+ 3	5,76650+ 0	28	3	2	1009
2,26022+ 3	5,76590+ 0	2,27907+ 3	5,75100+ 0	2,34554+ 3	5,69790+ 0	28	3	2	1010
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4,20081+ 3	3,90760+ 0	4,57079+ 3	3,50520+ 0	5,02787+ 3	3,07890+ 0	28	3	2	1012
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5,52931+ 3	2,51950+ 0	5,52953+ 3	2,51940+ 0	5,52978+ 3	2,51860+ 0	28	3	2	1014
5,52985+ 3	2,51830+ 0	5,53001+ 3	2,51700+ 0	5,53015+ 3	2,51540+ 0	28	3	2	1015
5,53032+ 3	2,51550+ 0	5,53047+ 3	2,51540+ 0	5,53069+ 3	2,51540+ 0	28	3	2	1016
5,53101+ 3	2,51550+ 0	5,53148+ 3	2,51530+ 0	5,53218+ 3	2,51470+ 0	28	3	2	1017
5,54488+ 3	2,50200+ 0	5,86555+ 3	2,19260+ 0	6,88784+ 3	1,35510+ 0	28	3	2	1018
6,88853+ 3	1,35510+ 0	6,88900+ 3	1,35550+ 0	6,88932+ 3	1,35600+ 0	28	3	2	1019

6,88954+ 3	1,35660+ 0	6,68979+ 3	1,35680+ 0	6,88985+ 3	1,35570+ 0	28	3	2	1020
6,89001+ 3	1,35220+ 0	6,89015+ 3	1,34880+ 0	6,89031+ 3	1,34750+ 0	28	3	2	1021
6,89046+ 3	1,34780+ 0	6,89068+ 3	1,34830+ 0	6,89100+ 3	1,34900+ 0	28	3	2	1022
6,69147+ 3	1,34930+ 0	6,89216+ 3	1,34930+ 0	6,90005+ 3	1,34410+ 0	28	3	2	1023
8,09744+ 3	4,03580- 1	8,41520+ 3	1,47850- 1	8,61219+ 3	-1,25800- 2	28	3	2	1024
8,90718+ 3	-2,55730- 1	9,27816+ 3	-6,96960- 1	9,51637+ 3	-8,95900- 1	28	3	2	1025
9,52001+ 3	-9,19300- 1	9,53692+ 3	-9,18280- 1	9,55652+ 3	-9,34040- 1	28	3	2	1026
9,79790+ 3	-1,13870+ 0	1,06447+ 4	-1,82750+ 0	1,07777+ 4	-1,92140+ 0	28	3	2	1027
1,11636+ 4	-2,14420+ 0	1,15680+ 4	-2,27870+ 0	1,19092+ 4	-2,36780+ 0	28	3	2	1028
1,21950+ 4	-2,53010+ 0	1,32972+ 4	-3,57980+ 0	1,32981+ 4	-3,56700+ 0	28	3	2	1029
1,32997+ 4	-3,54920+ 0	1,33013+ 4	-3,68120+ 0	1,33019+ 4	-3,67460+ 0	28	3	2	1030
1,33028+ 4	-3,65720+ 0	1,33419+ 4	-3,65700+ 0	1,35963+ 4	-3,81610+ 0	28	3	2	1031
1,35975+ 4	-3,80410+ 0	1,35983+ 4	-3,79760+ 0	1,35997+ 4	-3,67370+ 0	28	3	2	1032
1,36012+ 4	-3,86500+ 0	1,36017+ 4	-3,88580+ 0	1,36025+ 4	-3,86920+ 0	28	3	2	1033
1,36037+ 4	-3,86390+ 0	1,36964+ 4	-3,91360+ 0	1,39881+ 4	-4,22020+ 0	28	3	2	1034
1,43964+ 4	-4,48750+ 0	1,44575+ 4	-4,50090+ 0	1,46761+ 4	-4,38190+ 0	28	3	2	1035
1,47904+ 4	-4,16270+ 0	1,50169+ 4	-3,20150+ 0	1,51712+ 4	-2,43890+ 0	28	3	2	1036
1,55000+ 4	-1,56800+ 0	1,56908+ 4	-1,51400+ 0	1,58288+ 4	-1,21400+ 0	28	3	2	1037
1,59831+ 4	-6,28000- 1	1,64448+ 4	9,20400- 1	1,65425+ 4	1,09400+ 0	28	3	2	1038
1,70315+ 4	1,42930+ 0	1,73576+ 4	1,40540+ 0	1,78804+ 4	1,24680+ 0	28	3	2	1039
1,68050+ 4	9,22500- 1	1,89968+ 4	8,64500- 1	1,89978+ 4	8,65600- 1	28	3	2	1040
1,89997+ 4	8,64390- 1	1,90015+ 4	8,52900- 1	1,90022+ 4	8,54800- 1	28	3	2	1041
1,90102+ 4	8,56000- 1	1,97943+ 4	6,35400- 1	1,99946+ 4	5,92300- 1	28	3	2	1042
1,99963+ 4	5,95000- 1	1,99975+ 4	5,99300- 1	1,99983+ 4	6,06600- 1	28	3	2	1043
1,99997+ 4	6,03390- 1	2,00012+ 4	5,57100- 1	2,00017+ 4	5,62700- 1	28	3	2	1044
2,00025+ 4	5,68000- 1	2,00037+ 4	5,72600- 1	2,00251+ 4	5,76200- 1	28	3	2	1045
2,03552+ 4	5,01000- 1	2,07868+ 4	4,10700- 1	2,09549+ 4	3,82200- 1	28	3	2	1046
2,10027+ 4	3,77800- 1	2,10327+ 4	3,79000- 1	2,10542+ 4	3,85600- 1	28	3	2	1047
2,10688+ 4	3,98400- 1	2,10788+ 4	4,19000- 1	2,10856+ 4	4,50700- 1	28	3	2	1048
2,10933+ 4	5,21400- 1	2,10954+ 4	5,92100- 1	2,10969+ 4	5,32800- 1	28	3	2	1049
2,10979+ 4	4,97900- 1	2,11000+ 4	3,77400- 1	2,11021+ 4	2,66300- 1	28	3	2	1050
2,11031+ 4	2,44000- 1	2,11067+ 4	2,23200- 1	2,11098+ 4	2,42500- 1	28	3	2	1051
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2,11458+ 4	3,03800- 1	2,11673+ 4	3,09100- 1	2,11988+ 4	3,09500- 1	28	3	2	1053
2,13132+ 4	2,95600- 1	2,26326+ 4	7,34000- 2	2,31029+ 4	-2,20000- 3	28	3	2	1054
2,37694+ 4	-1,07900- 1	2,37791+ 4	-1,08600- 1	2,37858+ 4	-1,08400- 1	28	3	2	1055
2,37903+ 4	-1,07200- 1	2,37934+ 4	-1,05000- 1	2,37955+ 4	-1,01500- 1	28	3	2	1056
2,37969+ 4	-9,66000- 2	2,37979+ 4	-8,66000- 2	2,37985+ 4	-9,00000- 2	28	3	2	1057
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2,38014+ 4	-1,52100- 1	2,38021+ 4	-1,33800- 1	2,38030+ 4	-1,32700- 1	28	3	2	1059
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2,65984+ 4	-6,47300- 1	2,65989+ 4	-5,95800- 1	2,65997+ 4	-6,01690- 1	28	3	2	1065
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3,35734+ 4	-3,59000- 2	3,36819+ 4	-3,14000- 2	3,39079+ 4	-2,90000- 2	28	3	2	1101
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.73300E	06	.22497E	01	.73360E	06	.28397E	01	.73420E	06	.22897E	01	28	3	2	1428
.73520E	06	.14397E	01	.73640E	06	.11497E	01	.73730E	06	.15997E	01	28	3	2	1429
.73790E	06	.19397E	01	.73910E	06	.30197E	01	.73970E	06	.26597E	01	28	3	2	1430
.74030E	06	.24497E	01	.74100E	06	.19398E	01	.74160E	06	.14698E	01	28	3	2	1431
.74220E	06	.11798E	01	.74280E	06	.11298E	01	.74340E	06	.14898E	01	28	3	2	1432
.74440E	06	.24098E	01	.74500E	06	.26298E	01	.74530E	06	.22298E	01	28	3	2	1433
.74590E	06	.23798E	01	.74680E	06	.23598E	01	.74810E	06	.27798E	01	28	3	2	1434
.74870E	06	.25398E	01	.74900E	06	.25798E	01	.74930E	06	.26898E	01	28	3	2	1435
.74970E	06	.29298E	01	.75000E	06	.29148E	01	.75030E	06	.28998E	01	28	3	2	1436
.75120E	06	.35998E	01	.75150E	06	.37198E	01	.75190E	06	.36098E	01	28	3	2	1437
.75310E	06	.26898E	01	.75370E	06	.26398E	01	.75440E	06	.29698E	01	28	3	2	1438
.75600E	06	.36298E	01	.75720E	06	.40498E	01	.75760E	06	.39198E	01	28	3	2	1439

.75910E	06	.42698E 01	.76040E 06	.47398E 01	.76200E 06	.44498E 01	28	3	2	1440
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.77080E	06	.34098E 01	.77210E 06	.34698E 01	.77370E 06	.35498E 01	28	3	2	1444
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.79210E	06	.47798E 01	.79360E 06	.35598E 01	.79480E 06	.29898E 01	28	3	2	1451
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.79960E	06	.38698E 01	.80000E 06	.42069E 01	.80030E 06	.44598E 01	28	3	2	1453
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.80450E	06	.34998E 01	.80620E 06	.33898E 01	.80690E 06	.34698E 01	28	3	2	1455
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.82870E	06	.43496E 01	.83020E 06	.43896E 01	.83200E 06	.41996E 01	28	3	2	1463
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.83600E	06	.32896E 01	.83710E 06	.37596E 01	.83790E 06	.40596E 01	28	3	2	1465
.83860E	06	.35195E 01	.83940E 06	.27895E 01	.84050E 06	.31195E 01	28	3	2	1466
.84120E	06	.34895E 01	.84200E 06	.35395E 01	.84230E 06	.32995E 01	28	3	2	1467
.84350E	06	.28895E 01	.84530E 06	.36095E 01	.84610E 06	.33695E 01	28	3	2	1468
.84720E	06	.37295E 01	.84830E 06	.44895E 01	.84870E 06	.45895E 01	28	3	2	1469
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.85170E	06	.29594E 01	.85360E 06	.29994E 01	.85440E 06	.32994E 01	28	3	2	1471
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.85790E	06	.22894E 01	.85940E 06	.19294E 01	.86130E 06	.18894E 01	28	3	2	1473
.86320E	06	.16594E 01	.86400E 06	.19594E 01	.86480E 06	.24593E 01	28	3	2	1474
.86600E	06	.31493E 01	.86640E 06	.31993E 01	.86750E 06	.23293E 01	28	3	2	1475
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.87060E	06	.31593E 01	.87300E 06	.32693E 01	.87340E 06	.30493E 01	28	3	2	1477
.87420E	06	.31093E 01	.87540E 06	.32793E 01	.87770E 06	.33692E 01	28	3	2	1478
.87650E	06	.28792E 01	.87900E 06	.27042E 01	.87930E 06	.25992E 01	28	3	2	1479
.88090E	06	.24192E 01	.88170E 06	.19892E 01	.88210E 06	.18692E 01	28	3	2	1480
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.88410E	06	.34992E 01	.88530E 06	.28492E 01	.88610E 06	.27092E 01	28	3	2	1482
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.88900E	06	.42992E 01	.88980E 06	.49891E 01	.89020E 06	.50391E 01	28	3	2	1484
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.89380E	06	.38591E 01	.89470E 06	.36691E 01	.89630E 06	.36991E 01	28	3	2	1486
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.90750E	06	.38990E 01	.90910E 06	.40290E 01	.91040E 06	.38390E 01	28	3	2	1491
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.92050E	06	.33289E 01	.92180E 06	.32589E 01	.92350E 06	.37089E 01	28	3	2	1494
.92440E	06	.38389E 01	.92520E 06	.35388E 01	.92610E 06	.28188E 01	28	3	2	1495
.92740E	06	.23588E 01	.92900E 06	.19398E 01	.92950E 06	.18088E 01	28	3	2	1496
.93080E	06	.26688E 01	.93210E 06	.36488E 01	.93260E 06	.39588E 01	28	3	2	1497
.93350E	06	.38488E 01	.93480E 06	.34888E 01	.93650E 06	.35387E 01	28	3	2	1498
.93780E	06	.36487E 01	.93830E 06	.37687E 01	.93910E 06	.35087E 01	28	3	2	1499

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.94350E	06	.36687E	01	.94490E	06	.33887E	01	.94580E	06	.34187E	01	28	3	2	1501
.94750E	06	.29886E	01	.94980E	06	.23986E	01	.95000E	06	.23675E	01	28	3	2	1502
.95160E	06	.22986E	01	.95250E	06	.26086E	01	.95380E	06	.33086E	01	28	3	2	1503
.95470E	06	.34886E	01	.95610E	06	.30386E	01	.95790E	06	.28385E	01	28	3	2	1504
.95880E	06	.31085E	01	.95970E	06	.37285E	01	.96060E	06	.39285E	01	28	3	2	1505
.96240E	06	.33285E	01	.96420E	06	.27185E	01	.96510E	06	.28985E	01	28	3	2	1506
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.99940E	06	.36781E	01	.99990E	06	.34281E	01	.10000E	07	.33381E	01	28	3	2	1515
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.10160E	07	.30779E	01	.10180E	07	.21879E	01	.10200E	07	.23779E	01	28	3	2	1518
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.10320E	07	.24177E	01	.10330E	07	.24077E	01	.10350E	07	.29277E	01	28	3	2	1520
.10380E	07	.31276E	01	.10400E	07	.27343E	01	.10410E	07	.25376E	01	28	3	2	1521
.10430E	07	.31375E	01	.10440E	07	.41475E	01	.10460E	07	.36475E	01	28	3	2	1522
.10500E	07	.26374E	01	.10520E	07	.31374E	01	.10550E	07	.19074E	01	28	3	2	1523
.10570E	07	.21773E	01	.10590E	07	.28473E	01	.10610E	07	.31673E	01	28	3	2	1524
.10630E	07	.33772E	01	.10670E	07	.21172E	01	.10700E	07	.23371E	01	28	3	2	1525
.10730E	07	.31071E	01	.10750E	07	.24470E	01	.10760E	07	.21170E	01	28	3	2	1526
.10790E	07	.31670E	01	.10810E	07	.37069E	01	.10830E	07	.42869E	01	28	3	2	1527
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.10960E	07	.19467E	01	.10980E	07	.25567E	01	.11000E	07	.30099E	01	28	3	2	1529
.11010E	07	.32366E	01	.11040E	07	.28966E	01	.11050E	07	.30448E	01	28	3	2	1530
.11100E	07	.37864E	01	.11120E	07	.35764E	01	.11140E	07	.40964E	01	28	3	2	1531
.11130E	07	.29063E	01	.11210E	07	.21462E	01	.11240E	07	.28262E	01	28	3	2	1532
.11280E	07	.18461E	01	.11310E	07	.27961E	01	.11350E	07	.31260E	01	28	3	2	1533
.11330E	07	.21559E	01	.11390E	07	.19659E	01	.11400E	07	.23559E	01	28	3	2	1534
.11430E	07	.37458E	01	.11450E	07	.36858E	01	.11480E	07	.32658E	01	28	3	2	1535
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.11720E	07	.40854E	01	.11740E	07	.27454E	01	.11770E	07	.17253E	01	28	3	2	1539
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.12360E	07	.39403E	01	.12370E	07	.42402E	01	.12380E	07	.42600E	01	28	3	2	1550
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.12580E	07	.33779E	01	.12600E	07	.31843E	01	.12610E	07	.30675E	01	28	3	2	1554
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.37000E	07	.18436E 01	.37030E 07	.18140E 01	.37130E 07	.19053E 01	28	3	2	1759
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.37410E	07	.21309E 01	.37480E 07	.22246E 01	.37500E 07	.22049E 01	28	3	2	1761
.37590E	07	.21228E 01	.37630E 07	.20826E 01	.37660E 07	.20521E 01	28	3	2	1762
.37760E	07	.20706E 01	.37940E 07	.20479E 01	.38000E 07	.19950E 01	28	3	2	1763
.38090E	07	.19155E 01	.38230E 07	.20632E 01	.38340E 07	.19914E 01	28	3	2	1764
.38480E	07	.21591E 01	.38670E 07	.21859E 01	.38850E 07	.19630E 01	28	3	2	1765
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.39260E	07	.18781E 01	.39380E 07	.21070E 01	.39530E 07	.19556E 01	28	3	2	1767
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.41010E	07	.18753E 01	.41300E 07	.20490E 01	.41540E 07	.18538E 01	28	3	2	1772
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.42200E	07	.20205E 01	.42330E 07	.20883E 01	.42460E 07	.19462E 01	28	3	2	1774
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.45000E	07	.21210E 01	.45210E 07	.19845E 01	.45400E 07	.19157E 01	28	3	2	1780
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.48000E	07	.19328E 01	.48090E 07	.18809E 01	.48290E 07	.20199E 01	28	3	2	1785
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.49230E	07	.18551E 01	.49490E 07	.18738E 01	.49760E 07	.20324E 01	28	3	2	1787
.49960E	07	.20713E 01	.50000E 07	.20832E 01	.50030E 07	.21011E 01	28	3	2	1788
.50560E	07	.20597E 01	.50910E 07	.20289E 01	.51130E 07	.20083E 01	28	3	2	1789
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.52270E	07	.20854E 01	.52560E 07	.20646E 01	.52970E 07	.20436E 01	28	3	2	1791
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.54240E	07	.19270E 01	.54420E 07	.19572E 01	.54670E 07	.19473E 01	28	3	2	1794
.54920E	07	.20175E 01	.55000E 07	.19819E 01	.55100E 07	.19375E 01	28	3	2	1795
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.56250E	07	.19877E 01	.56700E 07	.20378E 01	.56900E 07	.20078E 01	28	3	2	1797
.57100E	07	.20378E 01	.57230E 07	.21479E 01	.57630E 07	.19979E 01	28	3	2	1798
.58000E	07	.21153E 01	.58040E 07	.21260E 01	.58380E 07	.20481E 01	28	3	2	1799

.58720E 07	.20681E 01	.59000E 07	.20545E 01	.59130E 07	.20485E 01	28	3	2	1800
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.64000E 07	.20519E 01	.64010E 07	.20519E 01	.64020E 07	.20519E 01	28	3	2	1804
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.66050E 07	.20648E 01	.70000E 07	.20449E 01	.70160E 07	.20437E 01	28	3	2	1806
.71900E 07	.20359E 01	.74010E 07	.20306E 01	.74300E 07	.20312E 01	28	3	2	1807
.75000E 07	.20328E 01	.76100E 07	.20363E 01	.78080E 07	.20221E 01	28	3	2	1808
.79540E 07	.20337E 01	.79910E 07	.20366E 01	.80000E 07	.20371E 01	28	3	2	1809
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.90520E 07	.19275E 01	.93920E 07	.18908E 01	.95000E 07	.18797E 01	28	3	2	1812
.96920E 07	.18616E 01	.97510E 07	.18561E 01	.10000E 08	.18338E 01	28	3	2	1813
.10130E 08	.18140E 01	.10500E 08	.17660E 01	.10540E 08	.17614E 01	28	3	2	1814
.10960E 08	.17115E 01	.11000E 08	.17056E 01	.11420E 08	.16452E 01	28	3	2	1815
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.12000E 08	.15556E 01	.12250E 08	.15247E 01	.12410E 08	.15094E 01	28	3	2	1817
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.13000E 08	.14642E 01	.13500E 08	.14187E 01	.13560E 08	.14135E 01	28	3	2	1819
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.14870E 08	.12866E 01	.15000E 08	.12822E 01	.15500E 08	.12536E 01	28	3	2	1821
.15590E 08	.12487E 01	.16000E 08	.12318E 01	.16370E 08	.12147E 01	28	3	2	1822
.16500E 08	.12118E 01	.17000E 08	.12013E 01	.17210E 08	.11949E 01	28	3	2	1823
.17500E 08	.11868E 01	.18000E 08	.11727E 01	.18120E 08	.11666E 01	28	3	2	1824
.18500E 08	.11546E 01	.19000E 08	.11376E 01	.19100E 08	.11340E 01	28	3	2	1825
.19500E 08	.11183E 01	.20000E 08	.10988E 01	.00000E 00	.00000E 00	28	3	2	1826
.00000E 00	.00000E 00					28	3	0	1827
2.80000+ 4	5.81826+ 1	0	99	0	0	28	3	4	1828
0.0 + 0	-1.172 + 6	0	0	1	57	28	3	4	1829
57	2	0	0	0	0	28	3	4	1830
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.14500E 07	.14513E 00	.14790E 07	.15955E 00	.15000E 07	.32000E 00	28	3	4	1832
.15500E 07	.28090E 00	.16000E 07	.30380E 00	.16500E 07	.41470E 00	28	3	4	1833
.17000E 07	.37760E 00	.17500E 07	.43450E 00	.18000E 07	.49040E 00	28	3	4	1834
.18500E 07	.42130E 00	.19000E 07	.45720E 00	.19500E 07	.52810E 00	28	3	4	1835
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.22500E 07	.61100E 00	.23240E 07	.66270E 00	.24000E 07	.73580E 00	28	3	4	1837
.25000E 07	.76350E 00	.25480E 07	.78884E 00	.26000E 07	.82120E 00	28	3	4	1838
.26700E 07	.83411E 00	.28000E 07	.87810E 00	.28220E 07	.87834E 00	28	3	4	1839
.29000E 07	.93720E 00	.30000E 07	.97030E 00	.30100E 07	.96937E 00	28	3	4	1840
.31100E 07	.10601E 01	.32000E 07	.10807E 01	.32500E 07	.10898E 01	28	3	4	1841
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.35500E 07	.11817E 01	.36000E 07	.11808E 01	.36890E 07	.11759E 01	28	3	4	1843
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.40500E 07	.12351E 01	.42500E 07	.12438E 01	.43000E 07	.12410E 01	28	3	4	1845
.45000E 07	.12296E 01	.50000E 07	.11886E 01	.60000E 07	.10868E 01	28	3	4	1846
.70000E 07	.99565E 00	.80000E 07	.89130E 00	.90000E 07	.79330E 00	28	3	4	1847
.10000E 08	.69330E 00	.12000E 08	.57410E 00	.14000E 08	.42790E 00	28	3	4	1848
.16000E 08	.30027E 00	.18000E 08	.18313E 00	.20000E 08	.13600E 00	28	3	4	1849
.00000E 00	.00000E 00					28	3	0	1850
2.80000+ 4	5.81826+ 1	0	99	0	0	28	3	16	1851
0.0000E+00	-7.8195E+06	0	0	1	22	28	3	16	1852
22	2	0	0	0	0	28	3	16	1853
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.11500E 08	.66720E-02	.11750E 08	.83400E-02	.12000E 08	.13900E-01	28	3	16	1855
.12410E 08	.28147E-01	.13000E 08	.51526E-01	.13500E 08	.74677E-01	28	3	16	1856
.14000E 08	.98547E-01	.14500E 08	.11681E 00	.15000E 08	.13435E 00	28	3	16	1857
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 .20000E 08 .21147E 00                                                       28 3 16 1860
 .00000E 00 .00000E 00                                                       28 3 16 1861
 2.80000+ 4 5.81626+ 1         0          99           0           0         28 3  0 1862
 0.0000E+00-6.2950E+06         0           0           1           8         28 3 22 1863
          8          2         0           0           0           0         28 3 22 1864
 .64010E 07 .00000E 00 .60000E 07 .50000E-02 .10000E 08 .15000E-01         28 3 22 1865
 .12000E 08 .30000E-01 .14000E 08 .40000E-01 .16000E 08 .48000E-01         28 3 22 1866
 .18000E 08 .54000E-01 .20000E 08 .56000E-01 .00000E 00 .00000E 00         28 3 22 1867
 .00000E 00 .00000E 00                                                       28 3 22 1868
 2.80000+ 4 5.81626+ 1         0          99           0           0         28 3  0 1869
 0.0000E+00-8.1772E+06         0           0           1           8         28 3 28 1870
          8          2         0           0           0           0         28 3 28 1871
 .63190E 07 .00000E 00 .96920E 07 .58808E-01 .10000E 08 .73108E-01         28 3 28 1872
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 .18000E 08 .59878E 00 .20000E 08 .65883E 00 .00000E 00 .00000E 00         28 3 28 1874
 .00000E 00 .00000E 00                                                       28 3 28 1875
 2.80000+ 4 5.81826+ 1         0           1           0           0         28 3  0 1876
 0.0      + 0-.11720E 07       0           0           1          11         28 3 51 1877
         11          2         0           0           0           0         28 3 51 1878
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 .14000E 08 .10000E-02 .20000E 08 .10000E-02 .00000E 00 .00000E 00         28 3 51 1882
 .00000E 00 .00000E 00                                                       28 3 51 1883
 2.80000+ 4 5.81826+ 1         0           2           0           0         28 3  0 1884
 0.0      + 0-.13330E 07       0           0           1          27         28 3 52 1885
         27          2         0           0           0           0         28 3 52 1886
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 .15000E 07 .14000E 00 .15500E 07 .13500E 00 .16000E 07 .12200E 00         28 3 52 1888
 .16500E 07 .12200E 00 .17000E 07 .14400E 00 .17500E 07 .12000E 00         28 3 52 1889
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 .24000E 07 .17600E 00 .26000E 07 .17100E 00 .28000E 07 .16200E 00         28 3 52 1892
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 .50000E 07 .59000E-01 .60000E 07 .42000E-01 .80000E 07 .25000E-01         28 3 52 1894
 .10000E 08 .18000E-01 .14000E 08 .97000E-02 .20000E 08 .90000E-02         28 3 52 1895
 .00000E 00 .00000E 00                                                       28 3 52 1896
 2.80000+ 4 5.81826+ 1         0           3           0           0         28 3  0 1897
 0.0      + 0-.14540E 07       0           0           1          26         28 3 53 1898
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 .50000E 07 .15000E 00 .60000E 07 .10000E 00 .80000E 07 .55000E-01         28 3 53 1906
 .10000E 08 .35000E-01 .12000E 08 .29000E-01 .14000E 08 .28000E-01         28 3 53 1907
 .16000E 08 .27000E-01 .20000E 08 .26000E-01 .00000E 00 .00000E 00         28 3 53 1908
 .00000E 00 .00000E 00                                                       28 3 53 1909
 2.80000+ 4 5.81826+ 1         0           4           0           0         28 3  0 1910
 0.0      + 0-.21580E 07       0           0           1          13         28 3 54 1911
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 .00000E 00 .00000E 00                                                       28 3 54 1918
                                                                             28 3  0 1919
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0,0     + 0-,26250E 07          0           0           1          11   28 3 58 1948
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0,0     + 0-,27750E 07          0           0           1          13   28 3 59 1956
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,00000E 00 ,00000E 00                                               28 3  0 1963
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0,0     + 0-,29600E 07          0           0           1          13   28 3 60 1965
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5.62997+ 4	9.17670- 3	5.63012+ 4	5.63300- 3	5.63018+ 4	8.20900- 3	28	3102	2147
5.63027+ 4	8.84900- 3	5.63039+ 4	9.18800- 3	5.63057+ 4	9.38130- 3	28	3102	2148
5.63084+ 4	9.32010- 3	5.63268+ 4	9.35600- 3	5.68953+ 4	9.30960- 3	28	3102	2149
5.68968+ 4	9.55800- 3	5.68978+ 4	9.48400- 3	5.68997+ 4	9.09600- 3	28	3102	2150
5.69015+ 4	1.12660- 2	5.69022+ 4	9.47600- 3	5.69032+ 4	9.58800- 3	28	3102	2151
5.69047+ 4	9.31950- 3	5.69148+ 4	9.34740- 3	5.91933+ 4	9.32020- 3	28	3102	2152
5.99231+ 4	9.31370- 3	6.03448+ 4	9.31000- 3	6.11287+ 4	9.29770- 3	28	3102	2153
6.16623+ 4	9.27430- 3	6.20256+ 4	9.24420- 3	6.23674+ 4	9.20670- 3	28	3102	2154
6.28000+ 4	9.16580- 3	6.33037+ 4	9.15750- 3	6.39411+ 4	9.17970- 3	28	3102	2155
6.43750+ 4	9.17420- 3	6.46703+ 4	9.12140- 3	6.48714+ 4	8.98150- 3	28	3102	2156
6.50082+ 4	8.70750- 3	6.51014+ 4	8.34770- 3	6.52080+ 4	8.08370- 3	28	3102	2157
6.52552+ 4	8.43460- 3	6.53000+ 4	9.13620- 3	6.53920+ 4	1.02610- 2	28	3102	2158
6.54986+ 4	1.00540- 2	6.55918+ 4	9.70260- 3	6.57286+ 4	9.43220- 3	28	3102	2159

6.59297+ 4	9.29230- 3	6.62250+ 4	9.23380- 3	6.73752+ 4	9.19260- 3	28	3102	2160
6.80984+ 4	1.70810- 2	7.05836+ 4	1.70460- 2	7.12902+ 4	1.70290- 2	28	3102	2161
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7.12997+ 4	1.54670- 2	7.13014+ 4	1.75170- 2	7.13021+ 4	1.71330- 2	28	3102	2163
7.13031+ 4	1.68620- 2	7.13045+ 4	1.70550- 2	7.13143+ 4	1.70320- 2	28	3102	2164
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7.59395+ 4	1.69740- 2	7.59588+ 4	1.69700- 2	7.60000+ 4	1.69730- 2	28	3102	2166
7.60889+ 4	1.69880- 2	7.70343+ 4	1.69700- 2	7.95977+ 4	1.69420- 2	28	3102	2167
7.97576+ 4	1.69400- 2	8.20436+ 4	1.69160- 2	8.32579+ 4	1.69040- 2	28	3102	2168
8.38283+ 4	1.68970- 2	8.54122+ 4	1.68730- 2	8.57014+ 4	1.68620- 2	28	3102	2169
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8.70732+ 4	1.36090- 2	8.71075+ 4	1.36560- 2	8.72321+ 4	1.21030- 2	28	3102	2173
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9.27241+ 4	1.06960- 2	9.29718+ 4	1.06890- 2	9.34277+ 4	1.07680- 2	28	3102	2178
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9.50792+ 4	1.08680- 2	9.51745+ 4	1.08590- 2	9.59735+ 4	1.08110- 2	28	3102	2180
9.59985+ 4	1.08100- 2	9.65067+ 4	1.07870- 2	9.69685+ 4	1.07600- 2	28	3102	2181
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9.88086+ 4	1.20680- 2	9.89503+ 4	1.17710- 2	9.90508+ 4	1.14920- 2	28	3102	2185
9.91146+ 4	1.13470- 2	9.93560+ 4	1.10240- 2	9.95111+ 4	1.09280- 2	28	3102	2186
9.97106+ 4	1.08610- 2	1.00000+ 5	1.07940- 2	1.00000+ 5	0.83000- 2	28	3102	2187
.10200E 06	.18140E-01	.10370E 06	.55400E-02	.10670E 06	.39420E-01	28	3102	2188
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.19800E 06	.14000E-01	.20600E 06	.10000E-01	.21600E 06	.10000E-01	28	3102	2202
.21000E 06	.10000E-01	.22000E 06	.13000E-01	.22400E 06	.98000E-02	28	3102	2203
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.50000E 07	.75000E-03	.80000E 07	.45000E-03	.10000E 08	.34000E-03	28	3102	2217
.15000E 08	.27000E-03	.20000E 08	.24000E-03	.00000E 00	.00000E 00	28	3102	2218
.00000E 00	.00000E 00					28	3 0	2219

2.80000+ 4	5.81826+ 1	0	99	0	0	28	3103	2220
0.00000+ 0	3.94700+ 5	0	0	1	101	28	3103	2221
101	2					28	3103	2222
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.15000E 07	.86871E-02	.16000E 07	.10840E-01	.17000E 07	.14418E-01	28	3103	2231
.16000E 07	.18710E-01	.19000E 07	.23714E-01	.20000E 07	.28006E-01	28	3103	2232
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.00000E 00	.00000E 00					28	3 0	2257
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0.0000E+00	-5.9520E+06	0	0	1	10	28	3104	2259
10	2	0	0	0	0	28	3104	2260
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.20000E 08	.24678E-01	.00000E 00	.00000E 00	.00000E 00	.00000E 00	28	3104	2264
.00000E 00	.00000E 00					28	3 0	2265
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0.00000+ 0	2.89020+ 6	0	0	1	32	28	3107	2267
32	2					28	3107	2268
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```
.00000E 00 .00000E 00
                                                                         28 3    0 2280
2.80000+ 4 5.81826+ 1          0          0          0          0        28 3251 2281
0.0      + 0 0.0      + 0      0          0          1         60        28 3251 2282
         60          2                                                   28 3251 2283
.10000E-05 .11461E-11 .50000E 05 .89177E-01 .10000E 06 .74772E-01        28 3251 2284
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.40000E 07 .64127E 00 .50000E 07 .75712E 00 .60000E 07 .82412E 00        28 3251 2301
.80000E 07 .85695E 00 .10000E 08 .88260E 00 .12000E 08 .88959E 00        28 3251 2302
.14000E 08 .87551E 00 .16000E 08 .89350E 00 .20000E 08 .90159E 00        28 3251 2303
                                                                         28 3    0 2304
2.80000+ 4 5.81826+ 1          0          0          0          0        28 3252 2305
0.0      + 0 0.0      + 0      0          0          1         60        28 3252 2306
         60          2                                                   28 3252 2307
.10000E-05 .15892E 00 .50000E 05 .15333E 00 .10000E 06 .15576E 00        28 3252 2308
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.25000E 07 .10349E 00 .26000E 07 .93930E-01 .27000E 07 .89137E-01        28 3252 2322
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                                                                         28 3    0 2328
2.80000+ 4 5.81826+ 1          0          0          0          0        28 3253 2329
0.0      + 0 0.0      + 0      0          0          1         60        28 3253 2330
         60          2                                                   28 3253 2331
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.00000E 00 .20000E 08          0          0         14          0  28 4  2 2547
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.32047E 00 .25276E 00 .18989E 00 .12210E 00 .63565E-01 .26792E-01  28 4  2 2549
.99704E-02 .30717E-02 .00000E 00 .00000E 00 .00000E 00 .00000E 00  28 4  2 2550
                                                                   28 4  0 2551
2.80000+ 4 5.81826+ 1          0          2          0          0  28 4 16 2552
0.0     + 0 5.81826+ 1          0          1          0          0  28 4 16 2553
0.0     + 0 0.0     + 0          0          0          1          2  28 4 16 2554
          2          2          0          0          0          0  28 4 16 2555
0.0     + 0 7.95400+ 6          0          0          1          2  28 4 16 2556
          2          2          0          0          0          0  28 4 16 2557
-1.0    + 0 5.0     - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0  28 4 16 2558
0.0     + 0 2.0     + 7          0          0          1          2  28 4 16 2559
          2          2          0          0          0          0  28 4 16 2560
-1.0    + 0 5.0     - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0  28 4 16 2561
0.0     + 0 0.0     + 0                                            28 4  0 2562
2.8     + 4 5.81826+ 1          0          2          0          0  28 4 22 2563
0.0     + 0 5.81826+ 1          0          1          0          0  28 4 22 2564
0.0     + 0 0.0     + 0          0          0          1          2  28 4 22 2565
          2          2          0          0          0          0  28 4 22 2566
0.0     + 0 6.401   + 6          0          0          1          2  28 4 22 2567
          2          2          0          0          0          0  28 4 22 2568
-1.0    + 0 5.0     - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0  28 4 22 2569
0.0     + 0 2.0     + 7          0          0          1          2  28 4 22 2570
          2          2          0          0          0          0  28 4 22 2571
-1.0    + 0 5.0     - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0  28 4 22 2572
.00000E 00 .00000E 00                                              28 4  0 2573
2.8     + 4 5.81826+ 1          0          2          0          0  28 4 28 2574
0.0     + 0 5.81826+ 1          0          1          0          0  28 4 28 2575
0.0     + 0 0.0     + 0          0          0          1          2  28 4 28 2576
          2          2          0          0          0          0  28 4 28 2577
0.0     + 0 8.319   + 6          0          0          1          2  28 4 28 2578
          2          2          0          0          0          0  28 4 28 2579
```

-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	28	2580
0.0	+ 0 2.0	+ 7	0	0	1	2	28	4	28	2581
	2	2	0	0	0	0	28	4	28	2582
-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	28	2583
.00000E 00	.00000E 00						28	4	0	2584
2.8	+ 4 5.81826	+ 1	0	2	0	0	28	4	51	2585
0.0	+ 0 5.81826	+ 1	0	2	0	0	28	4	51	2586
0.0	+ 0 0.0	+ 0	0	0	1	5	28	4	51	2587
	5	2	0	0	0	0	28	4	51	2588
0.0	+ 0 1.19200	+ 6	0	0	1	2	28	4	51	2589
	2	2	0	0	0	0	28	4	51	2590
-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	51	2591
0.0	+ 0 4.0	+ 6	0	0	1	2	28	4	51	2592
	2	2	0	0	0	0	28	4	51	2593
-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	51	2594
0.0	+ 0 8.0	+ 6	0	0	1	21	28	4	51	2595
	21	2	0	0	0	0	28	4	51	2596
-1.0	+ 0 .425	+ 0-0.9	+ 0 0.3955	+ 0-0.8	+ 0 0.372	+ 0	28	4	51	2597
-0.7	+ 0 .3545	+ 0-0.6	+ 0 0.3430	+ 0-0.5	+ 0 0.3375	+ 0	28	4	51	2598
-0.4	+ 0 .338	+ 0-0.3	+ 0 0.3445	+ 0-0.2	+ 0 0.357	+ 0	28	4	51	2599
-0.1	+ 0 .3755	+ 0 0.0	+ 0 0.4000	+ 0 0.1	+ 0 0.4305	+ 0	28	4	51	2600
.2	+ 0 .467	+ 0 0.3	+ 0 0.5095	+ 0 0.4	+ 0 0.558	+ 0	28	4	51	2601
.5	+ 0 .6125	+ 0 0.6	+ 0 0.6730	+ 0 0.7	+ 0 0.7395	+ 0	28	4	51	2602
.8	+ 0 .8120	+ 0 0.9	+ 0 0.8905	+ 0 1.0	+ 0 0.9750	+ 0	28	4	51	2603
0.0	+ 0 1.4	+ 7	0	0	1	21	28	4	51	2604
	21	2	0	0	0	0	28	4	51	2605
-1.0	+ 0 0.28	+ 0-0.9	+ 0 0.24650	+ 0-0.8	+ 0 0.22200	+ 0	28	4	51	2606
-0.7	+ 0 0.2065	+ 0-0.6	+ 0 0.2	+ 0-0.5	+ 0 0.2025	+ 0	28	4	51	2607
-0.4	+ 0 0.214	+ 0-0.3	+ 0 0.2345	+ 0-0.2	+ 0 0.264	+ 0	28	4	51	2608
-0.1	+ 0 0.3025	+ 0 0.0	+ 0 0.35	+ 0 0.1	+ 0 0.4065	+ 0	28	4	51	2609
0.2	+ 0 0.472	+ 0 0.3	+ 0 0.5465	+ 0 0.4	+ 0 0.63	+ 0	28	4	51	2610
0.5	+ 0 0.7225	+ 0 0.6	+ 0 0.824	+ 0 0.7	+ 0 0.9345	+ 0	28	4	51	2611
0.8	+ 0 1.054	+ 0 0.9	+ 0 1.1825	+ 0 1.0	+ 0 1.320	+ 0	28	4	51	2612
0.0	+ 0 2.0	+ 7	0	0	1	21	28	4	51	2613
	21	2	0	0	0	0	28	4	51	2614
-1.0	+ 0 0.23	+ 0-0.9	+ 0 0.19225	+ 0-0.8	+ 0 0.165	+ 0	28	4	51	2615
-0.7	+ 0 0.14825	+ 0-0.6	+ 0 0.142	+ 0-0.5	+ 0 0.14625	+ 0	28	4	51	2616
-0.4	+ 0 0.161	+ 0-0.3	+ 0 0.18625	+ 0-0.2	+ 0 0.222	+ 0	28	4	51	2617
-0.1	+ 0 0.26825	+ 0 0.0	+ 0 0.325	+ 0 0.1	+ 0 0.39225	+ 0	28	4	51	2618
0.2	+ 0 0.47	+ 0 0.3	+ 0 0.55825	+ 0 0.4	+ 0 0.657	+ 0	28	4	51	2619
0.5	+ 0 0.76625	+ 0 0.6	+ 0 0.886	+ 0 0.7	+ 0 1.01625	+ 0	28	4	51	2620
0.8	+ 0 1.157	+ 0 0.9	+ 0 1.3825	+ 0 1.0	+ 0 1.47	+ 0	28	4	51	2621
0.0	+ 0 0.0	+ 0					28	4	0	2622
2.8	+ 4 5.81826	+ 1	0	2	0	0	28	4	52	2623
0.0	+ 0 5.81826	+ 1	0	2	0	0	28	4	52	2624
0.0	+ 0 0.0	+ 0	0	0	1	5	28	4	52	2625
	5	2	0	0	0	0	28	4	52	2626
0.0	+ 0 1.355	+ 6	0	0	1	2	28	4	52	2627
	2	2	0	0	0	0	28	4	52	2628
-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	52	2629
0.0	+ 0 4.0	+ 6	0	0	1	2	28	4	52	2630
	2	2	0	0	0	0	28	4	52	2631
-1.0	+ 0 5.0	- 1 1.0	+ 0 5.0	- 1 0.0	+ 0 0.0	+ 0	28	4	52	2632
0.0	+ 0 8.0	+ 6	0	0	1	21	28	4	52	2633
	21	2	0	0	0	0	28	4	52	2634
-1.0	+ 0 .425	+ 0-0.9	+ 0 0.3955	+ 0-0.8	+ 0 0.372	+ 0	28	4	52	2635
-0.7	+ 0 .3545	+ 0-0.6	+ 0 0.3430	+ 0-0.5	+ 0 0.3375	+ 0	28	4	52	2636
-0.4	+ 0 .338	+ 0-0.3	+ 0 0.3445	+ 0-0.2	+ 0 0.357	+ 0	28	4	52	2637
-0.1	+ 0 .3755	+ 0 0.0	+ 0 0.4000	+ 0 0.1	+ 0 0.4305	+ 0	28	4	52	2638
.2	+ 0 .467	+ 0 0.3	+ 0 0.5095	+ 0 0.4	+ 0 0.558	+ 0	28	4	52	2639

,5	+ 0 ,6125	+ 0 0,6	+ 0 0,6730	+ 0 0.7	+ 0 0,7395	+ 0	28	4	52	2640
,8	+ 0 ,8120	+ 0 0,9	+ 0 0,8905	+ 0 1.0	+ 0 0,9750	+ 0	28	4	52	2641
0,0	+ 0 1,4	+ 7	0	0	1	21	28	4	52	2642
	21	2	0	0	0	0	28	4	52	2643
-1,0	+ 0 0,28	+ 0-0,9	+ 0 0,24650+	0-0,8	+ 0 0,22200+	0	28	4	52	2644
-0,7	+ 0 0,2065	+ 0-0,6	+ 0 0,2	+ 0-0,5	+ 0 0,2025	+ 0	28	4	52	2645
-0,4	+ 0 0,214	+ 0-0,3	+ 0 0,2345	+ 0-0,2	+ 0 0,264	+ 0	28	4	52	2646
-0,1	+ 0 0,3025	+ 0 0,0	+ 0 0,35	+ 0 0,1	+ 0 0,4065	+ 0	28	4	52	2647
0,2	+ 0 0,472	+ 0 0,3	+ 0 0,5465	+ 0 0,4	+ 0 0,63	+ 0	28	4	52	2648
0,5	+ 0 0,7225	+ 0 0,6	+ 0 0,824	+ 0 0,7	+ 0 0,9345	+ 0	28	4	52	2649
0,8	+ 0 1,054	+ 0 0,9	+ 0 1,1825	+ 0 1,0	+ 0 1,320	+ 0	28	4	52	2650
0,0	+ 0 2,0	+ 7	0	0	1	21	28	4	52	2651
	21	2	0	0	0	0	28	4	52	2652
-1,0	+ 0 0,23	+ 0-0,9	+ 0 0,19225+	0-0,8	+ 0 0,165	+ 0	28	4	52	2653
-0,7	+ 0 0,14825+	0-0,6	+ 0 0,142	+ 0-0,5	+ 0 0,14625+	0	28	4	52	2654
-0,4	+ 0 0,161	+ 0-0,3	+ 0 0,18625+	0-0,2	+ 0 0,222	+ 0	28	4	52	2655
-0,1	+ 0 0,26825+	0 0,0	+ 0 0,325	+ 0 0,1	+ 0 0,39225+	0	28	4	52	2656
0,2	+ 0 0,47	+ 0 0,3	+ 0 0,55825+	0 0,4	+ 0 0,657	+ 0	28	4	52	2657
0,5	+ 0 0,76625+	0 0,6	+ 0 0,886	+ 0 0,7	+ 0 1,01625+	0	28	4	52	2658
0,8	+ 0 1,157	+ 0 0,9	+ 0 1,3825	+ 0 1,0	+ 0 1,47	+ 0	28	4	52	2659
0,0	+ 0 0,0	+ 0					28	4	0	2660
2,8	+ 4 5,81826+	1	0	2	0	0	28	4	53	2661
0,0	+ 0 5,81826+	1	0	2	0	0	28	4	53	2662
0,0	+ 0 0,0	+ 0	0	0	1	5	28	4	53	2663
	5	2	0	0	0	0	28	4	53	2664
0,0	+ 0 1,479	+ 6	0	0	1	2	28	4	53	2665
	2	2	0	0	0	0	28	4	53	2666
-1,0	+ 0 5,0	- 1 1,0	+ 0 5,0	- 1 0,0	+ 0 0,0	+ 0	28	4	53	2667
0,0	+ 0 4,0	+ 6	0	0	1	2	28	4	53	2668
	2	2	0	0	0	0	28	4	53	2669
-1,0	+ 0 5,0	- 1 1,0	+ 0 5,0	- 1 0,0	+ 0 0,0	+ 0	28	4	53	2670
0,0	+ 0 8,0	+ 6	0	0	1	21	28	4	53	2671
	21	2	0	0	0	0	28	4	53	2672
-1,0	+ 0 ,425	+ 0-0,9	+ 0 0,3955	+ 0-0,8	+ 0 0,372	+ 0	28	4	53	2673
-0,7	+ 0 ,3545	+ 0-0,6	+ 0 0,3430	+ 0-0,5	+ 0 0,3375	+ 0	28	4	53	2674
-0,4	+ 0 ,338	+ 0-0,3	+ 0 0,3445	+ 0-0,2	+ 0 0,357	+ 0	28	4	53	2675
-0,1	+ 0 ,3755	+ 0 0,0	+ 0 0,4000	+ 0 0,1	+ 0 0,4305	+ 0	28	4	53	2676
,2	+ 0 ,467	+ 0 0,3	+ 0 0,5095	+ 0 0,4	+ 0 0,558	+ 0	28	4	53	2677
,5	+ 0 ,6125	+ 0 0,6	+ 0 0,6730	+ 0 0,7	+ 0 0,7395	+ 0	28	4	53	2678
,8	+ 0 ,8120	+ 0 0,9	+ 0 0,8905	+ 0 1,0	+ 0 0,9750	+ 0	28	4	53	2679
0,0	+ 0 1,4	+ 7	0	0	1	21	28	4	53	2680
	21	2	0	0	0	0	28	4	53	2681
-1,0	+ 0 0,28	+ 0-0,9	+ 0 0,24650+	0-0,8	+ 0 0,22200+	0	28	4	53	2682
-0,7	+ 0 0,2065	+ 0-0,6	+ 0 0,2	+ 0-0,5	+ 0 0,2025	+ 0	28	4	53	2683
-0,4	+ 0 0,214	+ 0-0,3	+ 0 0,2345	+ 0-0,2	+ 0 0,264	+ 0	28	4	53	2684
-0,1	+ 0 0,3025	+ 0 0,0	+ 0 0,35	+ 0 0,1	+ 0 0,4065	+ 0	28	4	53	2685
0,2	+ 0 0,472	+ 0 0,3	+ 0 0,5465	+ 0 0,4	+ 0 0,63	+ 0	28	4	53	2686
0,5	+ 0 0,7225	+ 0 0,6	+ 0 0,824	+ 0 0,7	+ 0 0,9345	+ 0	28	4	53	2687
0,8	+ 0 1,054	+ 0 0,9	+ 0 1,1825	+ 0 1,0	+ 0 1,320	+ 0	28	4	53	2688
0,0	+ 0 2,0	+ 7	0	0	1	21	28	4	53	2689
	21	2	0	0	0	0	28	4	53	2690
-1,0	+ 0 0,23	+ 0-0,9	+ 0 0,19225+	0-0,8	+ 0 0,165	+ 0	28	4	53	2691
-0,7	+ 0 0,14825+	0-0,6	+ 0 0,142	+ 0-0,5	+ 0 0,14625+	0	28	4	53	2692
-0,4	+ 0 0,161	+ 0-0,3	+ 0 0,18625+	0-0,2	+ 0 0,222	+ 0	28	4	53	2693
-0,1	+ 0 0,26825+	0 0,0	+ 0 0,325	+ 0 0,1	+ 0 0,39225+	0	28	4	53	2694
0,2	+ 0 0,47	+ 0 0,3	+ 0 0,55825+	0 0,4	+ 0 0,657	+ 0	28	4	53	2695
0,5	+ 0 0,76625+	0 0,6	+ 0 0,886	+ 0 0,7	+ 0 1,01625+	0	28	4	53	2696
0,8	+ 0 1,157	+ 0 0,9	+ 0 1,3825	+ 0 1,0	+ 0 1,47	+ 0	28	4	53	2697
0,0	+ 0 0,0	+ 0					28	4	0	2698
2,8	+ 4 5,81826+	1	0	2	0	0	28	4	54	2699

```
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 54 2700
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 54 2701
        2          2          0          0          0          0 28 4 54 2702
  0.0 + 0 2.195  + 6          0          0          1          2 28 4 54 2703
        2          2          0          0          0          0 28 4 54 2704
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 54 2705
  0.0 + 0 2.0    + 7          0          0          1          2 28 4 54 2706
        2          2          0          0          0          0 28 4 54 2707
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 54 2708
  0.0 + 0 0.0    + 0                                             28 4  0 2709
  2.8 + 4 5.81826+ 1          0          2          0          0 28 4 55 2710
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 55 2711
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 55 2712
        2          2          0          0          0          0 28 4 55 2713
  0.0 + 0 2.324  + 6          0          0          1          2 28 4 55 2714
        2          2          0          0          0          0 28 4 55 2715
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 55 2716
  0.0 + 0 2.0    + 7          0          0          1          2 28 4 55 2717
        2          2          0          0          0          0 28 4 55 2718
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 55 2719
  0.0 + 0 0.0    + 0                                             28 4  0 2720
  2.8 + 4 5.81826+ 1          0          2          0          0 28 4 56 2721
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 56 2722
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 56 2723
        2          2          0          0          0          0 28 4 56 2724
  0.0 + 0 2.5    + 6          0          0          1          2 28 4 56 2725
        2          2          0          0          0          0 28 4 56 2726
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 56 2727
  0.0 + 0 2.0    + 7          0          0          1          2 28 4 56 2728
        2          2          0          0          0          0 28 4 56 2729
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 56 2730
  0.0 + 0 0.0    + 0                                             28 4  0 2731
  2.8 + 4 5.81826+ 1          0          2          0          0 28 4 57 2732
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 57 2733
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 57 2734
        2          2          0          0          0          0 28 4 57 2735
  0.0 + 0 2.548  + 6          0          0          1          2 28 4 57 2736
        2          2          0          0          0          0 28 4 57 2737
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 57 2738
  0.0 + 0 2.0    + 7          0          0          1          2 28 4 57 2739
        2          2          0          0          0          0 28 4 57 2740
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 57 2741
  0.0 + 0 0.0    + 0                                             28 4  0 2742
  2.8 + 4 5.81826+ 1          0          2          0          0 28 4 58 2743
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 58 2744
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 58 2745
        2          2          0          0          0          0 28 4 58 2746
  0.0 + 0 2.67   + 6          0          0          1          2 28 4 58 2747
        2          2          0          0          0          0 28 4 58 2748
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 58 2749
  0.0 + 0 2.0    + 7          0          0          1          2 28 4 58 2750
        2          2          0          0          0          0 28 4 58 2751
 -1.0 + 0 5.0    - 1 1.0    + 0 5.0    - 1 0.0    + 0 0.0    + 0 28 4 58 2752
  0.0 + 0 0.0    + 0                                             28 4  0 2753
  2.8 + 4 5.81826+ 1          0          2          0          0 28 4 59 2754
  0.0 + 0 5.81826+ 1          0          2          0          0 28 4 59 2755
  0.0 + 0 0.0    + 0          0          0          1          2 28 4 59 2756
        2          2          0          0          0          0 28 4 59 2757
  0.0 + 0 2.822  + 6          0          0          1          2 28 4 59 2758
        2          2          0          0          0          0 28 4 59 2759
```

-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	59	2760
0.0	+ 0	2,0	+ 7		0		0		1		2	28	4	59	2761
	2		2		0		0		0		0	28	4	59	2762
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	59	2763
0.0	+ 0	0,0	+ 0									28	4	0	2764
2,8	+ 4	5,81826	+ 1		0		2		0		0	28	4	60	2765
0.0	+ 0	5,81826	+ 1		0		2		0		0	28	4	60	2766
0.0	+ 0	0,0	+ 0		0		0		1		2	28	4	60	2767
	2		2		0		0		0		0	28	4	60	2768
0.0	+ 0	3,01	+ 6		0		0		1		2	28	4	60	2769
	2		2		0		0		0		0	28	4	60	2770
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	60	2771
0.0	+ 0	2,0	+ 7		0		0		1		2	28	4	60	2772
	2		2		0		0		0		0	28	4	60	2773
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	60	2774
0.0	+ 0	0,0	+ 0									28	4	0	2775
2,8	+ 4	5,81826	+ 1		0		2		0		0	28	4	61	2776
0.0	+ 0	5,81826	+ 1		0		2		0		0	28	4	61	2777
0.0	+ 0	0,0	+ 0		0		0		1		2	28	4	61	2778
	2		2		0		0		0		0	28	4	61	2779
0.0	+ 0	3,325	+ 6		0		0		1		2	28	4	61	2780
	2		2		0		0		0		0	28	4	61	2781
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	61	2782
0.0	+ 0	2,0	+ 7		0		0		1		2	28	4	61	2783
	2		2		0		0		0		0	28	4	61	2784
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0.0	+ 0	28	4	61	2785
0.0	+ 0	0,0	+ 0									28	4	0	2786
2,8	+ 4	5,81826	+ 1		0		2		0		0	28	4	62	2787
0.0	+ 0	5,81826	+ 1		0		2		0		0	28	4	62	2788
0.0	+ 0	0,0	+ 0		0		0		1		2	28	4	62	2789
	2		2		0		0		0		0	28	4	62	2790
0.0	+ 0	3,689	+ 6		0		0		1		2	28	4	62	2791
	2		2		0		0		0		0	28	4	62	2792
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	62	2793
0.0	+ 0	2,0	+ 7		0		0		1		2	28	4	62	2794
	2		2		0		0		0		0	28	4	62	2795
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0.0	+ 0	0,0	+ 0									28	4	0	2797
2,8	+ 4	5,81826	+ 1		0		2		0		0	28	4	91	2798
0.0	+ 0	5,81826	+ 1		0		2		0		0	28	4	91	2799
0.0	+ 0	0,0	+ 0		0		0		1		2	28	4	91	2800
	2		2		0		0		0		0	28	4	91	2801
0.0	+ 0	3,763	+ 6		0		0		1		2	28	4	91	2802
	2		2		0		0		0		0	28	4	91	2803
-1.0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	91	2804
0,0	+ 0	2,0	+ 7		0		0		1		2	28	4	91	2805
	2		2		0		0		0		0	28	4	91	2806
-1,0	+ 0	5,0	- 1	1,0	+ 0	5,0	- 1	0.0	+ 0	0,0	+ 0	28	4	91	2807
0,0	+ 0	0,0	+ 0									28	4	0	2808
0,0	+ 0	0,0	+ 0									28	0	0	2809
2,8	+ 4	5,81826	+ 1		0		0		1		0	28	5	16	2810
7,954	+ 6	0,0	+ 0		0		9		1		2	28	5	16	2811
	2		2		0		0		0		0	28	5	16	2812
7,954	+ 6	1,0	+ 0	2,0	+ 7	1,0	+ 0					28	5	16	2813
0,0	+ 0	0,0	+ 0		0		0		1		7	28	5	16	2814
	7		2									28	5	16	2815
7,954	+ 6	1,0	+ 4	1,0	+ 7	3,6	+ 5	1,2	+ 7	5,00	+ 5	28	5	16	2816
1,4	+ 7	6,10	+ 5	1,6	+ 7	7,1	+ 5	1,8	+ 7	7,9	+ 5	28	5	16	2817
2,0	+ 7	8,7	+ 5									28	5	16	2818
0,0	+ 0	0,0	+ 0									28	5	0	2819

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6.401     + 6 0.0     + 0          0          9          1          2  28 5 22 2821
            2          2                                             28 5 22 2822
6.401     + 6 1.0     + 0 2.0     + 7 1.      + 0                    28 5 22 2823
0.0       + 0 0.0     + 0          0          0          1          4  28 5 22 2824
            4          2                                             28 5 22 2825
6.401     + 6 1.0     + 4 1.0     + 7 4.7     + 5 1.5     + 7 7.3     + 5  28 5 22 2826
2.0       + 7 9.2     + 5                                            28 5 22 2827
                                                                     28 5  0 2828
2.8       + 4 5.81826+ 1          0          0          1          0  28 5 28 2829
8.319     + 6 0.0     + 0          0          9          1          2  28 5 28 2830
            2          2                                             28 5 28 2831
8.319     + 6 1.0     + 0 2.0     + 7 1.0     + 0                    28 5 28 2832
0.0       + 0 0.0     + 0          0          0          1          4  28 5 28 2833
            4          2                                             28 5 28 2834
8.319     + 6 1.0     + 4 1.0     + 7 3.2     + 5 1.5     + 7 6.5     + 5  28 5 28 2835
2.0       + 7 8.5     + 5                                            28 5 28 2836
                                                                     28 5  0 2837
2.8       + 4 5.81826+ 1          0          0          1          0  28 5 91 2838
0.0       + 0 0.0     + 0          0          1          1          2  28 5 91 2839
            2          2                                             28 5 91 2840
3.763     + 6 1.0     + 0 2.0     + 7 1.0     + 0                    28 5 91 2841
0.0       + 0 0.0     + 0          0          0          1         11  28 5 91 2842
           11          1                                             28 5 91 2843
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.73800E 07	.31370E-07	.76260E 07	.29420E-07	.78720E 07	.27710E-07	28	5	91	2983
.81180E 07	.26210E-07	.83640E 07	.24880E-07	.86100E 07	.23720E-07	28	5	91	2984
.88560E 07	.22690E-07	.91020E 07	.21770E-07	.93480E 07	.20950E-07	28	5	91	2985
.95940E 07	.20220E-07	.98400E 07	.19560E-07	.10090E 08	.18960E-07	28	5	91	2986
.10330E 08	.18420E-07	.10580E 08	.17920E-07	.10820E 08	.17460E-07	28	5	91	2987
.11070E 08	.17040E-07	.11320E 08	.16640E-07	.11560E 08	.16260E-07	28	5	91	2988
.11810E 08	.15910E-07	.12050E 08	.15570E-07	.12300E 08	.15250E-07	28	5	91	2989
.12300E 08	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	28	5	91	2990
.00000E 00	.20000E 08	0	1	1	52	28	5	91	2991
52	2					28	5	91	2992
.10000E-04	.00000E 00	.32600E 06	.97870E-07	.65200E 06	.15790E-06	28	5	91	2993
.97800E 06	.19110E-06	.13040E 07	.20570E-06	.16300E 07	.20790E-06	28	5	91	2994
.19560E 07	.20160E-06	.22820E 07	.19070E-06	.26080E 07	.17670E-06	28	5	91	2995
.29340E 07	.16150E-06	.32600E 07	.14600E-06	.35860E 07	.13100E-06	28	5	91	2996
.39120E 07	.11680E-06	.42380E 07	.10370E-06	.45640E 07	.91850E-07	28	5	91	2997
.48900E 07	.81220E-07	.52160E 07	.71790E-07	.55420E 07	.63500E-07	28	5	91	2998
.58680E 07	.56250E-07	.61940E 07	.49950E-07	.65200E 07	.44500E-07	28	5	91	2999

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.66460E 07 .39790E-07 .71720E 07 .35750E-07 .74980E 07 .32270E-07
.76240E 07 .29290E-07 .81500E 07 .26740E-07 .84760E 07 .24550E-07 28 5 91 3000
.88020E 07 .22670E-07 .91280E 07 .21050E-07 .94540E 07 .19650E-07 28 5 91 3001
.97800E 07 .18440E-07 .10110E 08 .17390E-07 .10430E 08 .16470E-07 28 5 91 3002
.10760E 08 .15670E-07 .11080E 08 .14950E-07 .11410E 08 .14310E-07 28 5 91 3003
.11740E 08 .13740E-07 .12060E 08 .13220E-07 .12390E 08 .12750E-07 28 5 91 3004
.12710E 08 .12320E-07 .13040E 08 .11910E-07 .13370E 08 .11540E-07 28 5 91 3005
.13690E 08 .11180E-07 .14020E 08 .10850E-07 .14340E 08 .10530E-07 28 5 91 3006
.14670E 08 .10220E-07 .15000E 08 .99280E-08 .15320E 08 .96460E-08 28 5 91 3007
.15650E 08 .93720E-08 .15970E 08 .91060E-08 .16300E 08 .88500E-08 28 5 91 3008
.16300E 08 .00000E 00 .00000E 00 .00000E 00 .00000E 00 .00000E 00 28 5 91 3009
                                                                  28 5 91 3010
0.00000+ 0 0.00000+ 0          0          0          0            28 5  0 3011
2.8000E+04 5.8185E+01          1                                0 28 0  0 3012
0.         0.                                        1            2812102 3013
         2          2                     1          1          2 2812102 3014
1.0000E-05 1.4400E+00 2.0000E+07 4.6400E+00                       2812102 3015
                                                                  2812102 3016
                                                                  2812    0 3017
2.8000E+04 5.8185E+01                                             28 0    0 3018
                                                        19        2813    3 3019
        46          2                                1         46 2813    3 3020
1.1920E+06 0.         1.3550E+06 1.5877E-02 1.4000E+06 9.1260E-02 2813    3 3021
1.4500E+06 1.4513E-01 1.4790E+06 1.5955E-01 1.5000E+06 3.2000E-01 2813    3 3022
1.5500E+06 2.8090E-01 1.6000E+06 3.0380E-01 1.6500E+06 4.1470E-01 2813    3 3023
1.7000E+06 3.7760E-01 1.7500E+06 4.3450E-01 1.8000E+06 4.9040E-01 2813    3 3024
1.8500E+06 4.2130E-01 1.9000E+06 4.5720E-01 2.0000E+06 5.9900E-01 2813    3 3025
2.1950E+06 6.0046E-01 2.2000E+06 6.1140E-01 2.2500E+06 6.3837E-01 2813    3 3026
2.3240E+06 7.1579E-01 2.4000E+06 8.1530E-01 2.5000E+06 8.7965E-01 2813    3 3027
2.5480E+06 9.2259E-01 2.6000E+06 9.7400E-01 2.6700E+06 1.0115E+00 2813    3 3028
2.8000E+06 1.1012E+00 2.8220E+06 1.1183E+00 2.9000E+06 1.2369E+00 2813    3 3029
3.0000E+06 1.3466E+00 3.0100E+06 1.3547E+00 3.1100E+06 1.5358E+00 2813    3 3030
3.2000E+06 1.6376E+00 3.2500E+06 1.6569E+00 3.3250E+06 1.6718E+00 2813    3 3031
3.4000E+06 1.7317E+00 3.5000E+06 1.8495E+00 3.5500E+06 1.8546E+00 2813    3 3032
3.6000E+06 1.8572E+00 3.6890E+06 1.9123E+00 3.7500E+06 2.0001E+00 2813    3 3033
3.9999E+06 2.1519E+00 4.0000E+06 2.1519E+00 6.0000E+06 3.6800E+00 2813    3 3034
8.0000E+06 4.6100E+00 1.2000E+07 3.7500E+00 1.4000E+07 2.7600E+00 2813    3 3035
2.0000E+07 2.7500E+00                                             2813    3 3036
3.2700E+06 0.                                                     2813    3 3037
         5          2                     2          1          5 2813    3 3038
3.3250E+06 0.         3.5000E+06 6.9300E-02 3.7500E+06 1.0710E-01 2813    3 3039
3.9999E+06 1.1340E-01 4.0000E+06 0.                               2813    3 3040
2.9600E+06 0.                                                     2813    3 3041
         7          2                     2          1          7 2813    3 3042
3.0100E+06 0.         3.1100E+06 5.0000E-03 3.2500E+06 7.3000E-03 2813    3 3043
3.5000E+06 9.3000E-03 3.7500E+06 9.8000E-03 3.9999E+06 9.3000E-03 2813    3 3044
4.0000E+06 0.                                                     2813    3 3045
2.7750E+06 0.                                                     2813    3 3046
         8          2                     2          1          8 2813    3 3047
2.8220E+06 0.         2.9000E+06 2.3000E-03 3.0000E+06 3.6000E-03 2813    3 3048
3.2500E+06 5.0000E-03 3.5500E+06 5.6000E-03 3.7500E+06 5.6000E-03 2813    3 3049
3.9999E+06 5.3000E-03 4.0000E+06 0.                               2813    3 3050
2.1740E+06 0.                                                     2813    3 3051
         4          2                     2          1          4 2813    3 3052
3.6890E+06 0.         3.7500E+06 8.5000E-03 3.9999E+06 2.1300E-02 2813    3 3053
4.0000E+06 0.                                                     2813    3 3054
2.1580E+06 0.                                                     2813    3 3055
         9          2                     2          1          9 2813    3 3056
2.1950E+06 0.         2.2000E+06 9.0000E-04 2.4000E+06 5.4000E-03 2813    3 3057
2.6000E+06 7.2000E-03 2.8000E+06 9.0000E-03 3.0000E+06 1.0900E-02 2813    3 3058
                                                                  2813    3 3059
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 3.5000E+06 1.0600E-02 3.9999E+06 8.7000E-03 4.0000E+06 0.          2813  3 3060
 1.8160E+06 0.                                  2          1          5  2813  3 3061
          5          2                                                  2813  3 3062
 3.3250E+06 0.         3.5000E+06 4.0700E-02 3.7500E+06 6.2900E-02  2813  3 3063
 3.9999E+06 6.6600E-02 4.0000E+06 0.                                  2813  3 3064
 1.5060E+06 0.                                  2          1          7  2813  3 3065
          7          2                                                  2813  3 3066
 3.0100E+06 0.         3.1100E+06 9.5000E-02 3.2500E+06 1.3780E-01  2813  3 3067
 3.5000E+06 1.7580E-01 3.7500E+06 1.8530E-01 3.9999E+06 1.7580E-01  2813  3 3068
 4.0000E+06 0.                                                        2813  3 3069
 1.4540E+06 0.                                  2          1         22  2813  3 3070
         22          2                                                  2813  3 3071
 1.4790E+06 0.         1.5000E+06 1.5000E-01 1.5500E+06 1.1500E-01  2813  3 3072
 1.6000E+06 1.5000E-01 1.6500E+06 2.6000E-01 1.7000E+06 2.0000E-01  2813  3 3073
 1.7500E+06 2.8000E-01 1.8000E+06 3.2000E-01 1.8500E+06 2.5500E-01  2813  3 3074
 1.9000E+06 2.5000E-01 2.0000E+06 3.8000E-01 2.2500E+06 3.7000E-01  2813  3 3075
 2.4000E+06 4.4000E-01 2.6000E+06 4.8390E-01 2.8000E+06 5.1000E-01  2813  3 3076
 3.0000E+06 5.8240E-01 3.2000E+06 7.1570E-01 3.4000E+06 7.1660E-01  2813  3 3077
 3.5000E+06 7.5690E-01 3.6000E+06 7.5400E-01 3.9999E+06 8.8010E-01  2813  3 3078
 4.0000E+06 0.                                                        2813  3 3079
 1.3330E+06 0.                                  2          1         21  2813  3 3080
         21          2                                                  2813  3 3081
 1.3550E+06 0.         1.4000E+06 7.1000E-02 1.4500E+06 1.2000E-01  2813  3 3082
 1.5000E+06 1.4000E-01 1.5500E+06 1.3500E-01 1.6000E+06 1.2200E-01  2813  3 3083
 1.6500E+06 1.2200E-01 1.7000E+06 1.4400E-01 1.7500E+06 1.2000E-01  2813  3 3084
 1.8000E+06 1.3500E-01 1.8500E+06 1.3000E-01 1.9000E+06 1.7000E-01  2813  3 3085
 2.0000E+06 1.8000E-01 2.2000E+06 1.8910E-01 2.4000E+06 2.5010E-01  2813  3 3086
 2.6000E+06 2.9070E-01 2.8000E+06 3.2100E-01 3.0000E+06 3.3640E-01  2813  3 3087
 3.5000E+06 3.0260E-01 3.9999E+06 2.4100E-01 4.0000E+06 0.          2813  3 3088
 1.3210E+06 0.                                  2          1          8  2813  3 3089
          8          2                                                  2813  3 3090
 2.8220E+06 0.         2.9000E+06 5.5700E-02 3.0000E+06 8.6400E-02  2813  3 3091
 3.2500E+06 1.2000E-01 3.5500E+06 1.3440E-01 3.7500E+06 1.3440E-01  2813  3 3092
 3.9999E+06 1.2670E-01 4.0000E+06 0.                                  2813  3 3093
 1.2920E+06 0.                                  2          1          6  2813  3 3094
          6          2                                                  2813  3 3095
 2.6700E+06 0.         2.8000E+06 6.0000E-03 3.0000E+06 1.3500E-02  2813  3 3096
 3.5000E+06 1.6200E-02 3.9999E+06 1.5900E-02 4.0000E+06 0.          2813  3 3097
 1.1730E+06 0.                                  2          1          9  2813  3 3098
          9          2                                                  2813  3 3099
 2.5480E+06 0.         2.6000E+06 4.9000E-03 2.8000E+06 9.9000E-03  2813  3 3100
 3.0000E+06 1.3300E-02 3.2000E+06 1.5700E-02 3.4000E+06 1.6900E-02  2813  3 3101
 3.6000E+06 1.7400E-02 3.9999E+06 1.5700E-02 4.0000E+06 0.          2813  3 3102
 1.1720E+06 0.                                  2          1          7  2813  3 3103
          7          2                                                  2813  3 3104
 1.1920E+06 0.         1.5000E+06 3.0000E-02 2.0000E+06 3.9000E-02  2813  3 3105
 2.5000E+06 4.0000E-02 3.0000E+06 3.7000E-02 3.9999E+06 2.0000E-02  2813  3 3106
 4.0000E+06 0.                                                        2813  3 3107
 1.1690E+06 0.                                  2          1          4  2813  3 3108
          4          2                                                  2813  3 3109
 3.6890E+06 0.         3.7500E+06 4.1500E-02 3.9999E+06 1.0380E-01  2813  3 3110
 4.0000E+06 0.                                                        2813  3 3111
 1.0050E+06 0.                                  2          1          9  2813  3 3112
          9          2                                                  2813  3 3113
 2.5000E+06 0.         2.6000E+06 2.5900E-02 2.8000E+06 5.0000E-02  2813  3 3114
 3.0000E+06 6.6000E-02 3.2000E+06 7.9700E-02 3.4000E+06 8.5000E-02  2813  3 3115
 3.6000E+06 8.7000E-02 3.9999E+06 1.8280E-01 4.0000E+06 0.          2813  3 3116
 9.5300E+05 0.                                  2          1          8  2813  3 3117
          8          2                                                  2813  3 3118
 2.3240E+06 0.         2.4000E+06 2.0000E-02 2.6000E+06 4.2000E-02  2813  3 3119
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 2,6000E+06 5,3000E-02 3,0000E+06 5,5000E-02 3,5000E+06 5,4000E-02 2813  3 3120
 3,9999E+06 4,0000E-02 4,0000E+06 0,                                2813  3 3121
 8,2500E+05 0,                            2          1          9 2813  3 3122
          9          2                                              2813  3 3123
 2,1950E+06 0,         2,2000E+06 1,0000E-02 2,4000E+06 6,0000E-02 2813  3 3124
 2,6000E+06 8,0000E-02 2,8000E+06 9,0100E-02 3,0000E+06 1,1060E-01 2813  3 3125
 3,5000E+06 1,0720E-01 3,9999E+06 8,8400E-02 4,0000E+06 0,         2813  3 3126
 4,6700E+05 0,                            2          1          6 2813  3 3127
          6          2                                              2813  3 3128
 2,6700E+06 0,         2,8000E+06 1,4000E-02 3,0000E+06 3,1500E-02 2813  3 3129
 3,5000E+06 3,7800E-02 3,9999E+06 3,7100E-02 4,0000E+06 0,         2813  3 3130
 0,         0,                            1          1          7 2813  3 3131
          7          2                                              2813  3 3132
 3,9999E+06 0,         4,0000E+06 2,1519E+00 6,0000E+06 3,6800E+00 2813  3 3133
 8,0000E+06 4,6100E+00 1,2000E+07 3,7500E+00 1,4000E+07 2,7600E+00 2813  3 3134
 2,0000E+07 2,7500E+00                                              2813  3 3135
                                                                    2813  0 3136
                                                                    28 0  0 3137
 2,8000E+04 5,8185E+01          1                    19             2814  3 3138
                                                                    2814  0 3139
 2,8000E+04 5,8185E+01          1                     1             2814102 3140
                                                                    2814  0 3141
                                                                    28 0  0 3142
 2,8000E+04 5,8185E+01                                1             2815  3 3143
 0,                             0          1          1          2 2815  3 3144
          2          2                                              2815  3 3145
 3,9999E+06 1,0000E+00 2,0000E+07 1,0000E+00                       2815  3 3146
                                                      1          6 2815  3 3147
          6          2                                              2815  3 3148
 0,         3,9999E+06          0                     1         10 2815  3 3149
         10          1                                              2815  3 3150
 7,5000E+05 6,3860E-07 1,0000E+06 5,7580E-07 1,2500E+06 1,8833E-06 2815  3 3151
 1,5000E+06 2,8575E-07 1,7500E+06 1,6366E-07 2,0000E+06 9,4166E-08 2815  3 3152
 2,5000E+06 4,2212E-08 3,0000E+06 6,7216E-08 3,5000E+06 2,2838E-08 2815  3 3153
 4,0000E+06 0,                                                      2815  3 3154
 0,         6,0000E+06          0                     1         16 2815  3 3155
         16          1                                              2815  3 3156
 2,5000E+05 1,3630E-07 5,0000E+05 2,7261E-07 7,5000E+05 5,1796E-07 2815  3 3157
 1,0000E+06 5,4796E-07 1,2500E+06 1,2526E-06 1,5000E+06 2,8760E-07 2815  3 3158
 1,7500E+06 1,8401E-07 2,0000E+06 1,2336E-07 2,5000E+06 1,0973E-07 2815  3 3159
 3,0000E+06 9,1324E-08 3,5000E+06 3,6802E-08 4,0000E+06 2,3922E-08 2815  3 3160
 4,5000E+06 7,4968E-09 5,0000E+06 5,2478E-09 5,5000E+06 2,5898E-09 2815  3 3161
 6,0000E+06 0,                                                      2815  3 3162
 0,         8,0000E+06          0                     1         20 2815  3 3163
         20          1                                              2815  3 3164
 2,5000E+05 1,1730E-07 5,0000E+05 2,3460E-07 7,5000E+05 4,1876E-07 2815  3 3165
 1,0000E+06 5,1844E-07 1,2500E+06 9,7592E-07 1,5000E+06 2,8738E-07 2815  3 3166
 1,7500E+06 1,9472E-07 2,0000E+06 1,4193E-07 2,5000E+06 1,4662E-07 2815  3 3167
 3,0000E+06 1,1554E-07 3,5000E+06 7,1552E-08 4,0000E+06 4,6098E-08 2815  3 3168
 4,5000E+06 3,5952E-08 5,0000E+06 2,1758E-08 5,5000E+06 1,9002E-08 2815  3 3169
 6,0000E+06 1,4076E-08 6,5000E+06 6,3342E-09 7,0000E+06 4,9852E-09 2815  3 3170
 7,5000E+06 2,5806E-09 8,0000E+06 0,                                2815  3 3171
 0,         1,2000E+07          0                     1         23 2815  3 3172
         23          1                                              2815  3 3173
 2,5000E+05 1,3355E-07 5,0000E+05 2,6710E-07 7,5000E+05 3,8596E-07 2815  3 3174
 1,0000E+06 5,0216E-07 1,2500E+06 7,8928E-07 1,5000E+06 2,3238E-07 2815  3 3175
 1,7500E+06 1,6560E-07 2,0000E+06 1,2954E-07 2,5000E+06 1,2687E-07 2815  3 3176
 3,0000E+06 1,1085E-07 3,5000E+06 7,0782E-08 4,0000E+06 6,3504E-08 2815  3 3177
 4,5000E+06 4,8814E-08 5,0000E+06 4,1200E-08 5,5000E+06 4,1400E-08 2815  3 3178
 6,0000E+06 3,6126E-08 6,5000E+06 2,6978E-08 7,0000E+06 2,6110E-08 2815  3 3179
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7.5000E+06 1.6894E-08 8.0000E+06 1.4156E-08 8.5000E+06 4.7410E-09 2815  3 3180
9.0000E+06 4.0066E-09 9.5000E+06 0.                               2815  3 3181
0.         1.4000E+07          0          1         24            2815  3 3182
        24          1                                             2815  3 3183
2.5000E+05 1.8185E-07 5.0000E+05 3.6370E-07 7.5000E+05 3.9826E-07 2815  3 3184
1.0000E+06 5.3828E-07 1.2500E+06 8.0560E-07 1.5000E+06 2.4732E-07 2815  3 3185
1.7500E+06 1.7076E-07 2.0000E+06 1.2002E-07 2.5000E+06 1.0820E-07 2815  3 3186
3.0000E+06 1.0093E-07 3.5000E+06 5.8556E-08 4.0000E+06 3.9370E-08 2815  3 3187
4.5000E+06 4.7464E-08 5.0000E+06 2.7186E-08 5.5000E+06 3.4278E-08 2815  3 3188
6.0000E+06 3.4460E-08 6.5000E+06 1.8456E-08 7.0000E+06 1.9913E-08 2815  3 3189
7.5000E+06 1.4730E-08 8.0000E+06 1.4730E-08 8.5000E+06 3.1824E-09 2815  3 3190
9.0000E+06 2.9096E-09 9.5000E+06 2.7278E-09 1.0000E+07 0.         2815  3 3191
0.         2.0000E+07          0                     1         24 2815  3 3192
        24          1                                             2815  3 3193
2.5000E+05 1.8111E-07 5.0000E+05 3.6222E-07 7.5000E+05 4.8900E-07 2815  3 3194
1.0000E+06 6.3208E-07 1.2500E+06 7.8059E-07 1.5000E+06 3.0789E-07 2815  3 3195
1.7500E+06 2.2276E-07 2.0000E+06 1.2497E-07 2.5000E+06 1.2134E-07 2815  3 3196
3.0000E+06 6.9365E-08 3.5000E+06 4.7270E-08 4.0000E+06 2.8706E-08 2815  3 3197
4.5000E+06 2.2458E-08 5.0000E+06 2.3364E-08 5.5000E+06 1.3855E-08 2815  3 3198
6.0000E+06 2.0466E-08 6.5000E+06 1.3493E-08 7.0000E+06 5.5238E-09 2815  3 3199
7.5000E+06 6.7916E-09 8.0000E+06 6.4294E-09 8.5000E+06 6.2484E-09 2815  3 3200
9.0000E+06 1.1772E-09 9.5000E+06 7.2443E-10 1.0000E+07 0.         2815  0 3202
                                                                  2815  0 3202
                                                     1            2815102 3203
2.8000E+04 5.8185E+01          0          1          1          2 2815102 3204
0.                                                                2815102 3205
         2          2                                             2815102 3206
1.0000E-05 1.0000E+00 2.0000E+07 1.0000E+00                       2815102 3207
                                                     1          2 2815102 3208
         2          2                                             2815102 3209
0.         1.0000E-05          0                     1         36 2815102 3210
        36          1                                             2815102 3211
2.5000E+05 5.9092E-07 5.0000E+05 0.         7.5000E+05 1.3659E-07 2815102 3212
1.0000E+06 4.1812E-08 1.2500E+06 3.9024E-08 1.5000E+06 1.9512E-08 2815102 3213
1.7500E+06 8.3624E-08 2.0000E+06 4.1812E-08 2.2500E+06 1.3937E-08 2815102 3214
2.5000E+06 5.5748E-08 2.7500E+06 5.5748E-08 3.0000E+06 2.7875E-08 2815102 3215
3.2500E+06 2.5087E-08 3.5000E+06 2.7875E-08 3.7500E+06 1.9512E-08 2815102 3216
4.0000E+06 1.6725E-08 4.2500E+06 1.6725E-08 4.5000E+06 2.5087E-08 2815102 3217
4.7500E+06 4.4600E-08 5.0000E+06 2.2300E-08 5.2500E+06 5.5748E-08 2815102 3218
5.5000E+06 2.7875E-08 5.7500E+06 1.0035E-07 6.0000E+06 6.9684E-08 2815102 3219
6.2500E+06 2.5087E-08 6.5000E+06 6.9684E-08 6.7500E+06 3.1220E-07 2815102 3220
7.0000E+06 0.         7.2500E+06 5.5748E-09 7.5000E+06 1.5889E-07 2815102 3221
7.7500E+06 2.2857E-07 8.0000E+06 9.4772E-08 8.2500E+06 5.5748E-09 2815102 3222
8.5000E+06 4.7388E-07 8.7500E+06 1.0676E-06 9.0000E+06 0.         2815102 3223
0.         2.0000E+07          0                     1         36 2815102 3224
        36          1                                             2815102 3225
2.5000E+05 5.9092E-07 5.0000E+05 0.         7.5000E+05 1.3659E-07 2815102 3226
1.0000E+06 4.1812E-08 1.2500E+06 3.9024E-08 1.5000E+06 1.9512E-08 2815102 3227
1.7500E+06 8.3624E-08 2.0000E+06 4.1812E-08 2.2500E+06 1.3937E-08 2815102 3228
2.5000E+06 5.5748E-08 2.7500E+06 5.5748E-08 3.0000E+06 2.7875E-08 2815102 3229
3.2500E+06 2.5087E-08 3.5000E+06 2.7875E-08 3.7500E+06 1.9512E-08 2815102 3230
4.0000E+06 1.6725E-08 4.2500E+06 1.6725E-08 4.5000E+06 2.5087E-08 2815102 3231
4.7500E+06 4.4600E-08 5.0000E+06 2.2300E-08 5.2500E+06 5.5748E-08 2815102 3232
5.5000E+06 2.7875E-08 5.7500E+06 1.0035E-07 6.0000E+06 6.9684E-08 2815102 3233
6.2500E+06 2.5087E-08 6.5000E+06 6.9684E-08 6.7500E+06 3.1220E-07 2815102 3234
7.0000E+06 0.         7.2500E+06 5.5748E-09 7.5000E+06 1.5889E-07 2815102 3235
7.7500E+06 2.2857E-07 8.0000E+06 9.4772E-08 8.2500E+06 5.5748E-09 2815102 3236
8.5000E+06 4.7388E-07 8.7500E+06 1.0676E-06 9.0000E+06 0.         2815  0 3237
                                                                  28 0  0 3238
                                                                  28 0  0 3239
```

```
*EØF                                                                          28 0  0 3240
                                                                              28 0  0 3241
*********** ISØTØPIC REACTIØN FILES ***********                               28 0  0 3242
                                                                              28 0  0 3243
*********** NI-58 ISØTØPIC REACTIØN FILE **********                           28 0  0 3244
                                                                              28 0  0 3245
2.80000+ 4 5.80000+ 1          0          99           0           0          28 3 16 3246
0.0000E+00-1.2203E+07          0           0           1          16          28 3 16 3247
        16          2          0           0           0           0          28 3 16 3248
.12410E 08 .00000E 00 .13000E 08 .40000E-02 .13500E 08 .13000E-01          28 3 16 3249
.14000E 08 .23000E-01 .14500E 08 .31000E-01 .15000E 08 .38000E-01          28 3 16 3250
.15500E 08 .42500E-01 .16000E 08 .46000E-01 .16500E 08 .49000E-01          28 3 16 3251
.17000E 08 .51500E-01 .17500E 08 .54000E-01 .18000E 08 .56500E-01          28 3 16 3252
.18500E 08 .58800E-01 .19000E 08 .61000E-01 .19500E 08 .63600E-01          28 3 16 3253
.20000E 08 .66000E-01 .00000E 00 .00000E 00 .00000E 00 .00000E 00          28 3 16 3254
.00000E 00 .00000E 00                                                        28 3  0 3255
2.80000+ 4 5.80000+ 1          0          99           0           0          28 3 28 3256
0.0000E+00-8.1772E+06          0           0           1           7          28 3 28 3257
         7          2          0           0           0           0          28 3 28 3258
.83190E 07 .00000E 00 .10000E 08 .10000E 00 .12000E 08 .28400E 00          28 3 28 3259
.14500E 08 .55000E 00 .16000E 08 .68000E 00 .18000E 08 .80000E 00          28 3 28 3260
.20000E 08 .88000E 00 .11500E 08 .16400E-01 .12000E 08 .21000E-01          28 3 28 3261
.00000E 00 .00000E 00                                                        28 3  0 3262
2.80000+ 4 5.80000+ 1          0          99           0           0          28 3103 3263
0.00000+ 0 3.94700+ 5          0           0           1          88          28 3103 3264
        88          2                                                         28 3103 3265
.10000E 01 .00000E 00 .10000E 06 .28000E-05 .65000E 06 .28000E-05          28 3103 3266
.67000E 06 .12000E-04 .68000E 06 .23000E-04 .69000E 06 .34000E-04          28 3103 3267
.70000E 06 .44000E-04 .73000E 06 .81000E-04 .75000E 06 .11000E-03          28 3103 3268
.80000E 06 .19000E-03 .85000E 06 .30000E-03 .90000E 06 .46000E-03          28 3103 3269
.95000E 06 .68000E-03 .10000E 07 .10000E-02 .10400E 07 .15000E-02          28 3103 3270
.11000E 07 .25000E-02 .11400E 07 .33000E-02 .12000E 07 .42000E-02          28 3103 3271
.12600E 07 .50000E-02 .13000E 07 .55000E-02 .13400E 07 .65000E-02          28 3103 3272
.13600E 07 .75000E-02 .14000E 07 .90000E-02 .15000E 07 .12000E-01          28 3103 3273
.16000E 07 .15000E-01 .17000E 07 .20000E-01 .18000E 07 .26000E-01          28 3103 3274
.19000E 07 .33000E-01 .20000E 07 .39000E-01 .21000E 07 .46000E-01          28 3103 3275
.21900E 07 .53000E-01 .23000E 07 .75000E-01 .24000E 07 .90000E-01          28 3103 3276
.25000E 07 .10000E 00 .26000E 07 .11500E 00 .27000E 07 .13700E 00          28 3103 3277
.28[illegible]00E 07 .15200E 00 .29000E 07 .17500E 00 .29400E 07 .19300E 00          28 3103 3278
.29600E 07 .19800E 00 .29800E 07 .19800E 00 .30000E 07 .19300E 00          28 3103 3279
.30400E 07 .18300E 00 .30800E 07 .18100E 00 .31200E 07 .18800E 00          28 3103 3280
.32000E 07 .21500E 00 .32600E 07 .23100E 00 .32800E 07 .23000E 00          28 3103 3281
.33200E 07 .22300E 00 .33400E 07 .22100E 00 .34000E 07 .24000E 00          28 3103 3282
.35000E 07 .27300E 00 .36000E 07 .30000E 00 .37000E 07 .31700E 00          28 3103 3283
.38000E 07 .33000E 00 .39000E 07 .34500E 00 .40000E 07 .35000E 00          28 3103 3284
.41000E 07 .36300E 00 .42000E 07 .38500E 00 .43000E 07 .40000E 00          28 3103 3285
.44000E 07 .41000E 00 .47000E 07 .41000E 00 .48000E 07 .42500E 00          28 3103 3286
.50000E 07 .45700E 00 .53000E 07 .50000E 00 .54000E 07 .52000E 00          28 3103 3287
.58000E 07 .56000E 00 .59000E 07 .57000E 00 .61000E 07 .58500E 00          28 3103 3288
.63000E 07 .60000E 00 .64000E 07 .61000E 00 .66000E 07 .62000E 00          28 3103 3289
.70000E 07 .63000E 00 .75000E 07 .63500E 00 .85000E 07 .63500E 00          28 3103 3290
.95000E 07 .63000E 00 .10500E 08 .61500E 00 .11500E 08 .58000E 00          28 3103 3291
.12250E 08 .53000E 00 .13000E 08 .45000E 00 .13500E 08 .39500E 00          28 3103 3292
.14000E 08 .33700E 00 .15000E 08 .24800E 00 .16000E 08 .18800E 00          28 3103 3293
.17000E 08 .16800E 00 .18000E 08 .15700E 00 .19000E 08 .15200E 00          28 3103 3294
.20000E 08 .15000E 00 .00000E 00 .00000E 00 .00000E 00 .00000E 00          28 3103 3295
.00000E 00 .00000E 00                                                        28 3  0 3296
2.80000+ 4 5.80000+ 1          0          99           0           0          28 3104 3297
0.0000E+00-5.95200+06          0           0           1           9          28 3104 3298
         9          2          0           0           0           0          28 3104 3299
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.60560E 07 .00000E 00 .75000E 07 .31000E-03 .80000E 07 .93000E-03  28 3104 3300
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.16000E 08 .19800E-01 .18000E 08 .20500E-01 .20000E 08 .21000E-01  28 3104 3302
.00000E 00 .00000E 00                                              28 3    0 3303
2.80000+ 4 5.80000+ 1          0         99          0          0  28 3107 3304
0.00000+ 0 2.8[illegible]920+ 6          0          0          1         31  28 3107 3305
        31          2                                              28 3107 3306
.10000E 01 .00000E 00 .10000E 07 .48000E-02 .20000E 07 .90000E-02  28 3107 3307
.30000E 07 .15000E-01 .35000E 07 .20000E-01 .40000E 07 .25000E-01  28 3107 3308
.45000E 07 .32000E-01 .50000E 07 .40000E-01 .55000E 07 .52000E-01  28 3107 3309
.60000E 07 .65000E-01 .70000E 07 .85000E-01 .75000E 07 .94000E-01  28 3107 3310
.80000E 07 .10000E 00 .90000E 07 .11000E 00 .10000E 08 .11700E 00  28 3107 3311
.11000E 08 .12000E 00 .12000E 08 .12000E 00 .12500E 08 .11950E 00  28 3107 3312
.13000E 08 .11800E 00 .13500E 08 .11600E 00 .14000E 08 .11300E 00  28 3107 3313
.14500E 08 .10800E 00 .15000E 08 .10100E 00 .16500E 08 .80000E-01  28 3107 3314
.17000E 08 .72000E-01 .17500E 08 .66000E-01 .18000E 08 .60000E-01  28 3107 3315
.18500E 08 .54000E-01 .19000E 08 .50000E-01 .19500E 08 .45000E-01  28 3107 3316
.20000E 08 .40000E-01 .00000E 00 .00000E 00 .00000E 00 .00000E 00  28 3107 3317
.00000E 00 .00000E 00                                              28 3    0 3318
.00000E 00 .00000E 00                                              28 0    0 3319
                                                                   28 0    0 3320
                                                                   28 0    0 3321
********** NI-60 ISØTØPIC REACTIØN FILE **********                 28 0    0 3322
2.80000+ 4 6.00000+ 1          0         99          0          0  28 3 16 3323
0.0000E+00-1.1388E+07          0          0          1          7  28 3 16 3324
         7          2          0          0          0          0  28 3 16 3325
.11580E 08 .00000E 00 .12000E 08 .50000E-01 .13000E 08 .17500E 00  28 3 16 3326
.14000E 08 .29500E 00 .15000E 08 .38500E 00 .16000E 08 .44500E 00  28 3 16 3327
.20000E 08 .59000E 00 .00000E 00 .00000E 00 .00000E 00 .00000E 00  28 3 16 3328
.00000E 00 .00000E 00                                              28 3    0 3329
2.80000+ 4 6.00000+ 1          0         99          0          0  28 3 28 3330
0.0000E+00-9.5320E+06          0          0          1          6  28 3 28 3331
         6          2          0          0          0          0  28 3 28 3332
.96920E 07 .00000E 00 .12000E 08 .33900E-01 .14500E 08 .65000E-01  28 3 28 3333
.16000E 08 .80000E-01 .18000E 08 .93000E-01 .20000E 08 .10300E 00  28 3 28 3334
.00000E 00 .00000E 00                                              28 3    0 3335
2.80000+ 4 6.00000+ 1          0         99          0          0  28 3103 3336
0.00000+ 0-2.04000-06          0          0          1         32  28 3103 3337
        32          2                                              28 3103 3338
.20740E 07 .00000E 00 .21000E 07 .60000E-03 .22000E 07 .14000E-02  28 3103 3339
.23000E 07 .22000E-02 .25000E 07 .40000E-02 .30000E 07 .80000E-02  28 3103 3340
.35000E 07 .11000E-01 .40000E 07 .16000E-01 .45000E 07 .18000E-01  28 3103 3341
.50000E 07 .23000E-01 .55000E 07 .27000E-01 .60000E 07 .35000E-01  28 3103 3342
.65000E 07 .47000E-01 .70000E 07 .64000E-01 .75000E 07 .76000E-01  28 3103 3343
.80000E 07 .95000E-01 .85000E 07 .11900E 00 .90000E 07 .14600E 00  28 3103 3344
.95000E 07 .15500E 00 .10000E 08 .16000E 00 .10500E 08 .16100E 00  28 3103 3345
.11000E 08 .16000E 00 .11500E 08 .15800E 00 .12000E 08 .15300E 00  28 3103 3346
.13000E 08 .14200E 00 .14000E 08 .12600E 00 .15000E 08 .10900E 00  28 3103 3347
.16000E 08 .92000E-01 .17000E 08 .81000E-01 .18000E 08 .71000E-01  28 3103 3348
.19000E 08 .64000E-01 .20000E 08 .58000E-01 .00000E 00 .00000E 00  28 3103 3349
.00000E 00 .00000E 00                                              28 3    0 3350
2.80000+ 4 6.00000+ 1          0         99          0          0  28 3104 3351
0.0000E+00-7.3070E+06          0          0          1          9  28 3104 3352
         9          2          0          0          0          0  28 3104 3353
.74300E 07 .00000E 00 .75000E 07 .52000E-03 .80000E 07 .15700E-02  28 3104 3354
.13000E 08 .25000E-01 .14000E 08 .30000E-01 .15000E 08 .32400E-01  28 3104 3355
.16000E 08 .33400E-01 .18000E 08 .34600E-01 .20000E 08 .35400E-01  28 3104 3356
.00000E 00 .00000E 00                                              28 3    0 3357
2.80000+ 4 6.00000+ 1          0         99          0          0  28 3107 3358
0.00000+ 0 1.35200+ 6          0          0          1          9  28 3107 3359
```

```
         9           2                                                              28 3107 3360
,10000E 01 ,00000E 00 ,60000E 07 ,10000E-02 ,80000E 07 ,12000E-01  28 3107 3361
,10000E 08 ,30000E-01 ,12000E 08 ,55000E-01 ,14000E 08 ,75000E-01  28 3107 3362
,16000E 08 ,80000E-01 ,18000E 08 ,70000E-01 ,20000E 08 ,60000E-01  28 3107 3363
,00000E 00 ,00000E 00                                              28 3    0 3364
                                                                   28 0    0 3365
                                                                   28 0    0 3366
********** END ØF ENTIRE FILE **********                          28 0    0 3367
*EØF
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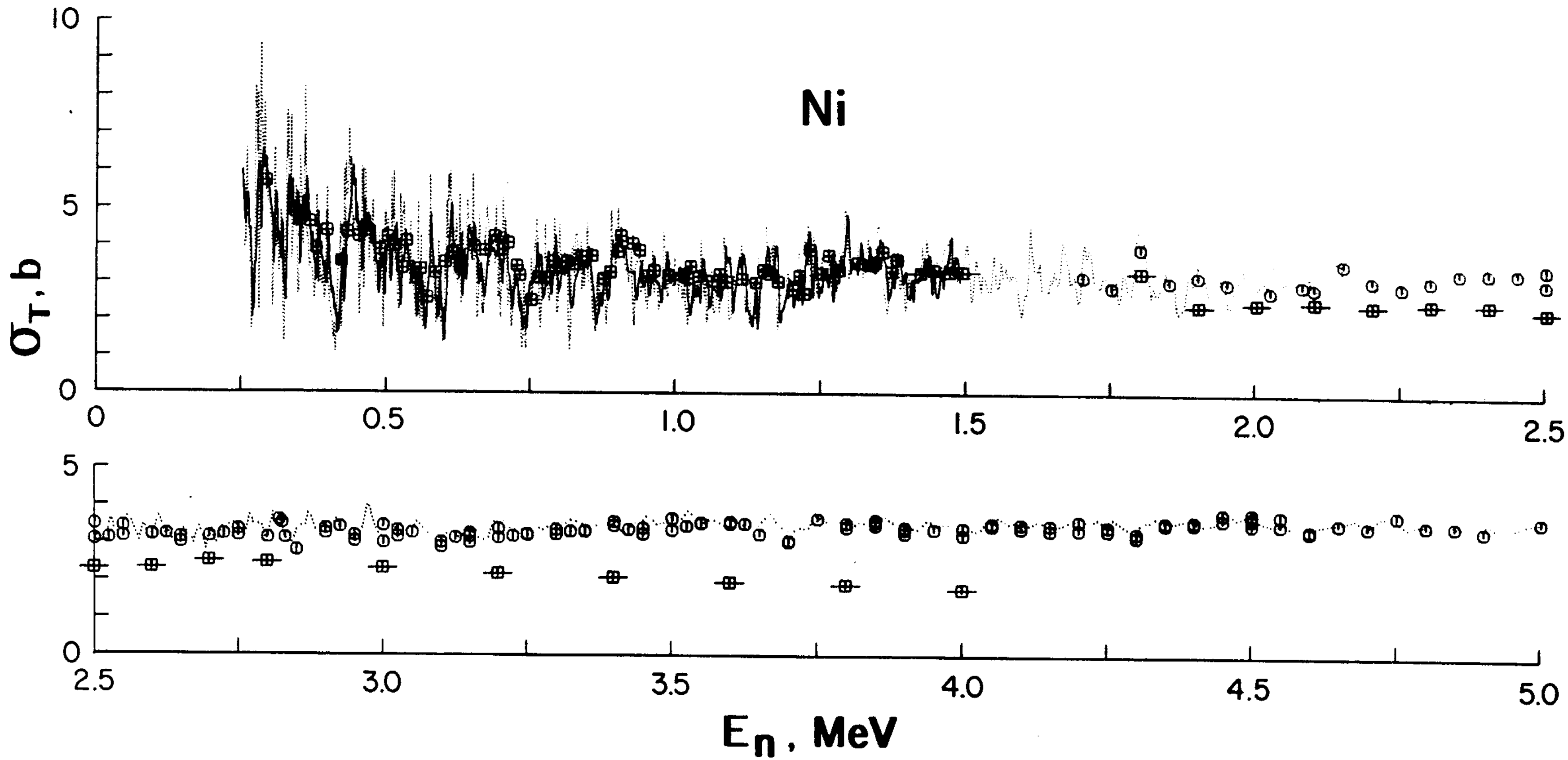


Fig. 1

Fig. 2

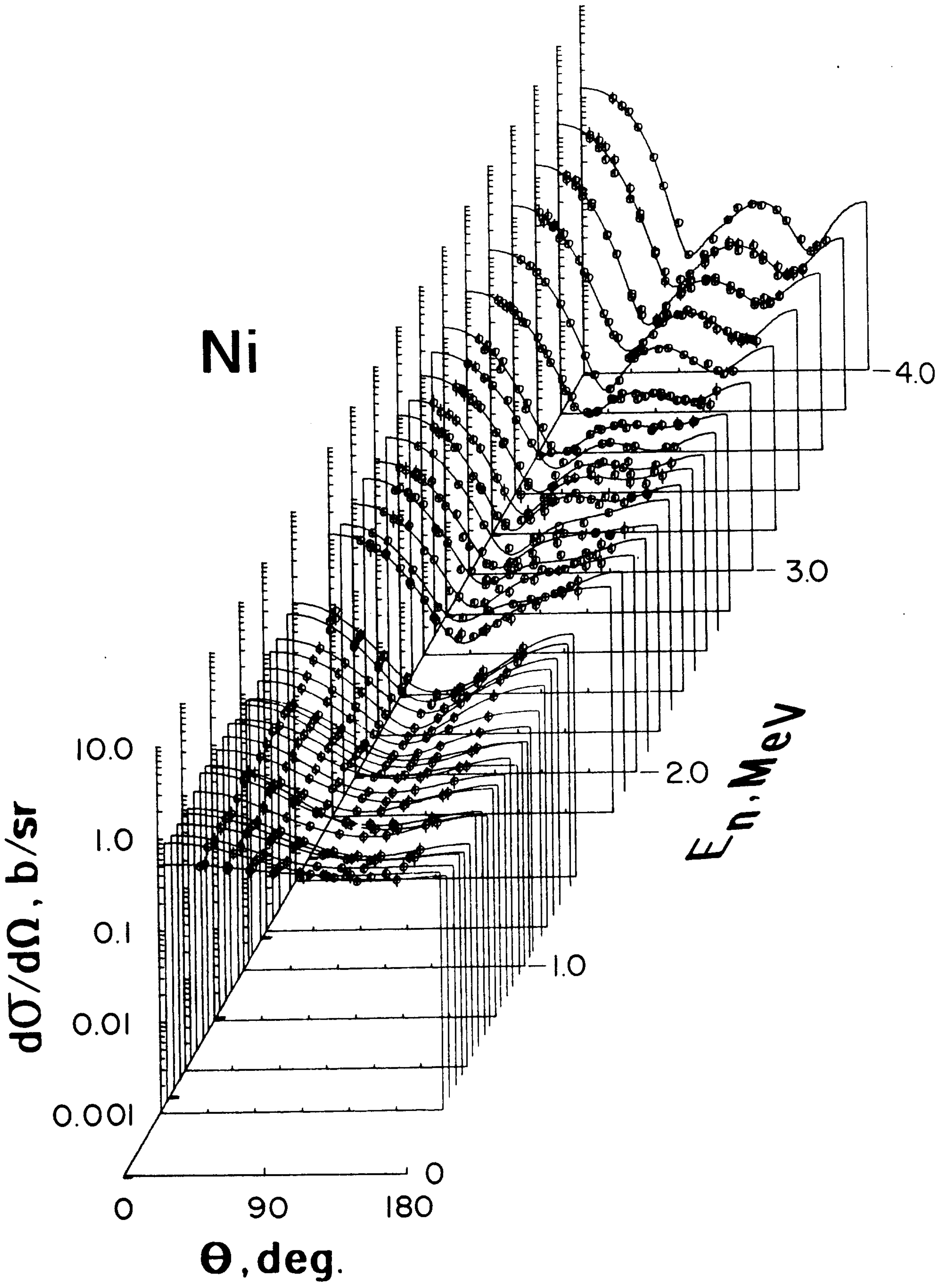
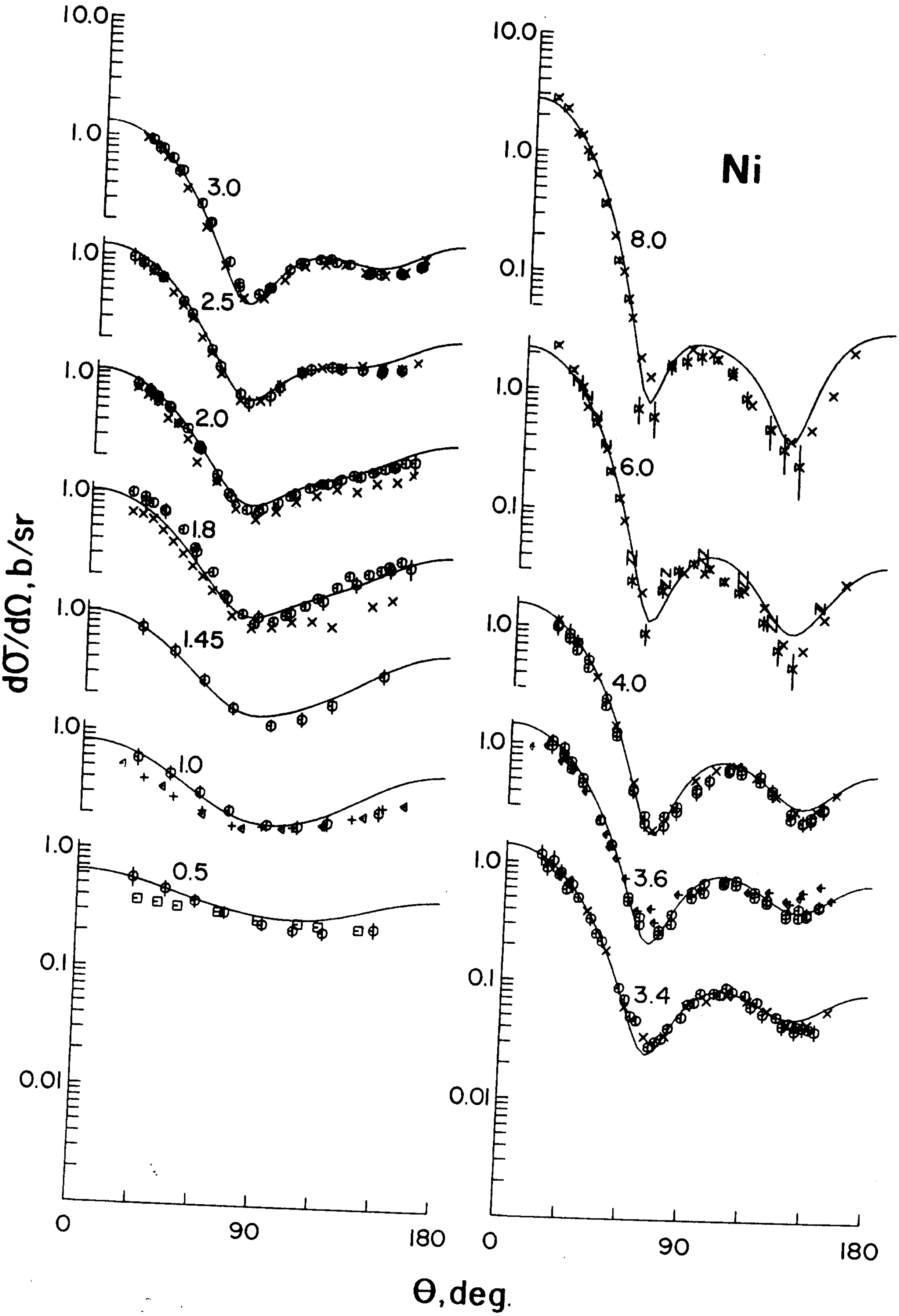
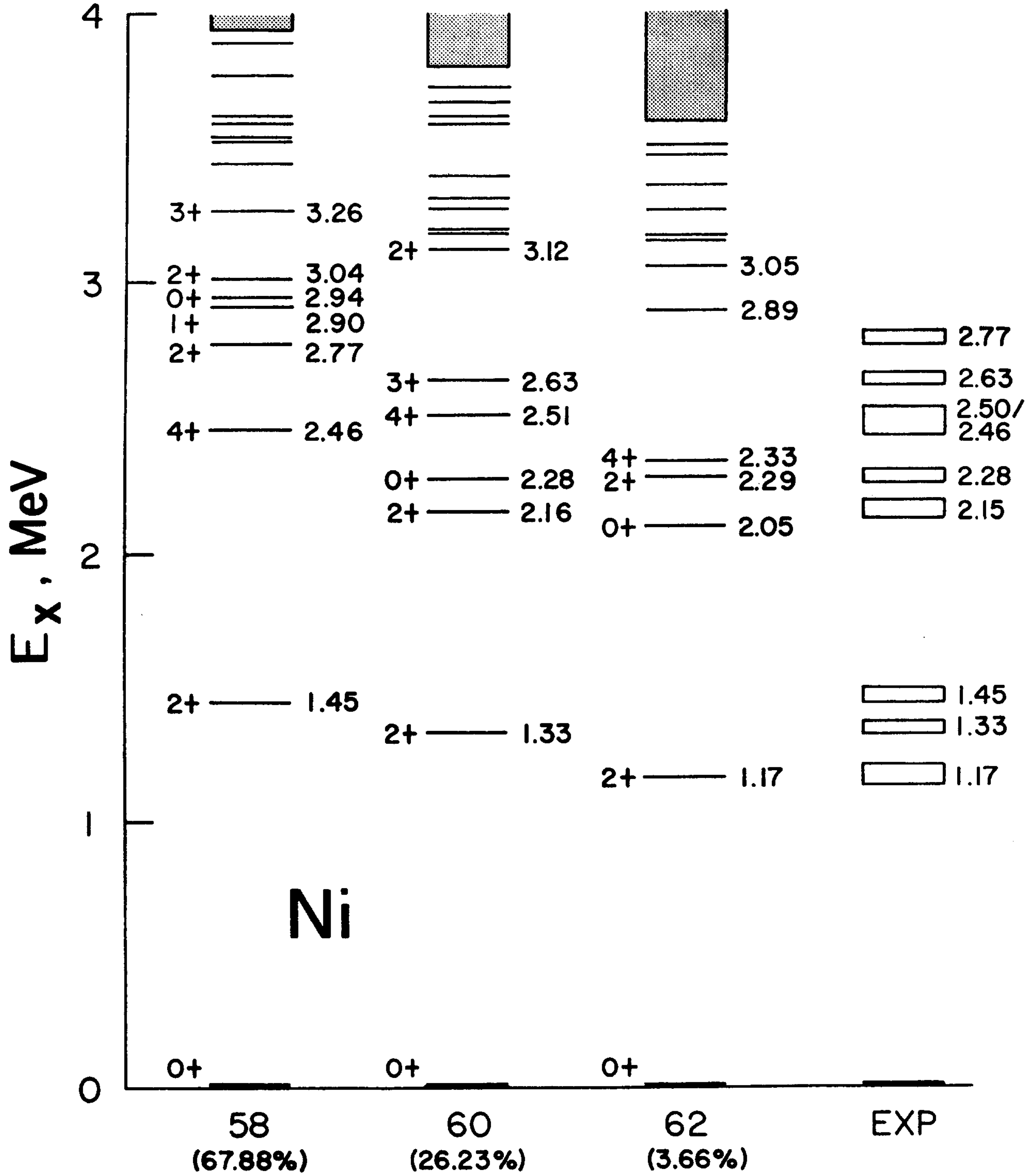


Fig. 3



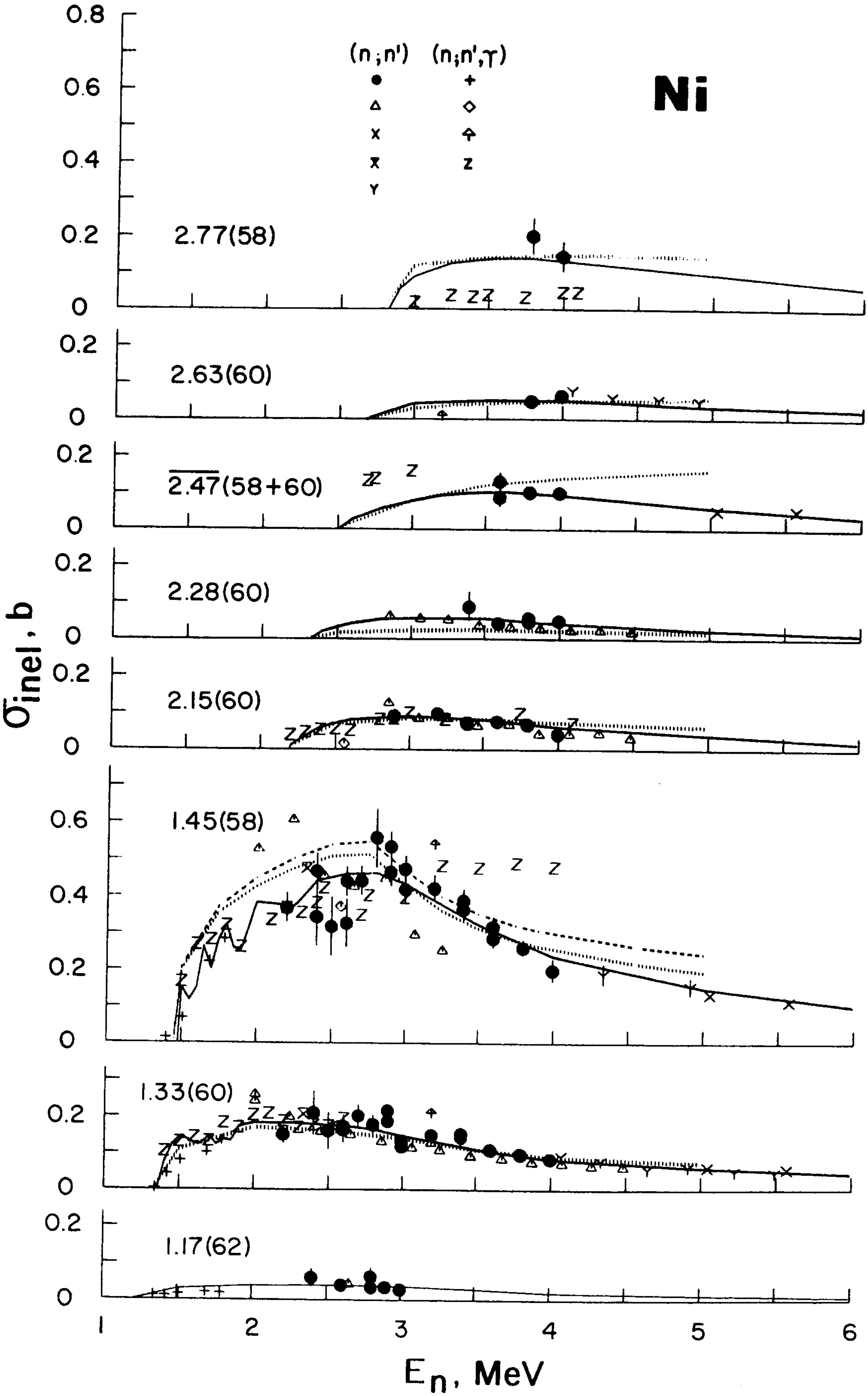
Ni
dσ/dΩ, b/sr
Θ, deg.
10.0
1.0
3.0
2.5
2.0
1.8
1.45
1.0
0.5
0.1
0.01
8.0
6.0
4.0
3.6
3.4
0
90
180

Fig. 4



4
3
2
1
0
E_x, MeV
3+
3.26
2+
3.04
0+
2.94
1+
2.90
2+
2.77
4+
2.46
2+
1.45
0+
2+
3.12
3+
2.63
4+
2.51
0+
2.28
2+
2.16
2+
1.33
0+
3.05
2.89
4+
2.33
2+
2.29
0+
2.05
2+
1.17
0+
2.77
2.63
2.50/
2.46
2.28
2.15
1.45
1.33
1.17
Ni
58
(67.88%)
60
(26.23%)
62
(3.66%)
EXP

Fig. 5



Ni
(n;n')
(n;n',γ)
2.77(58)
2.63(60)
2.47(58+60)
2.28(60)
2.15(60)
1.45(58)
1.33(60)
1.17(62)
σinel, b
En, MeV

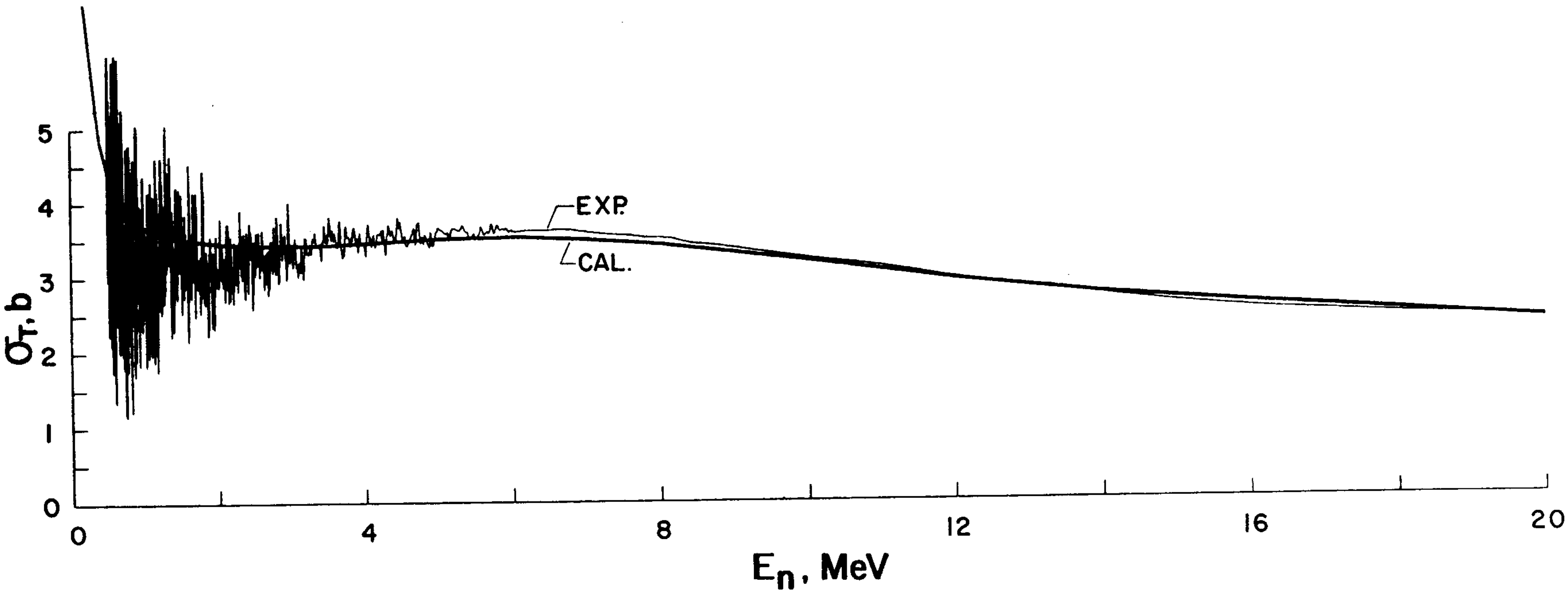
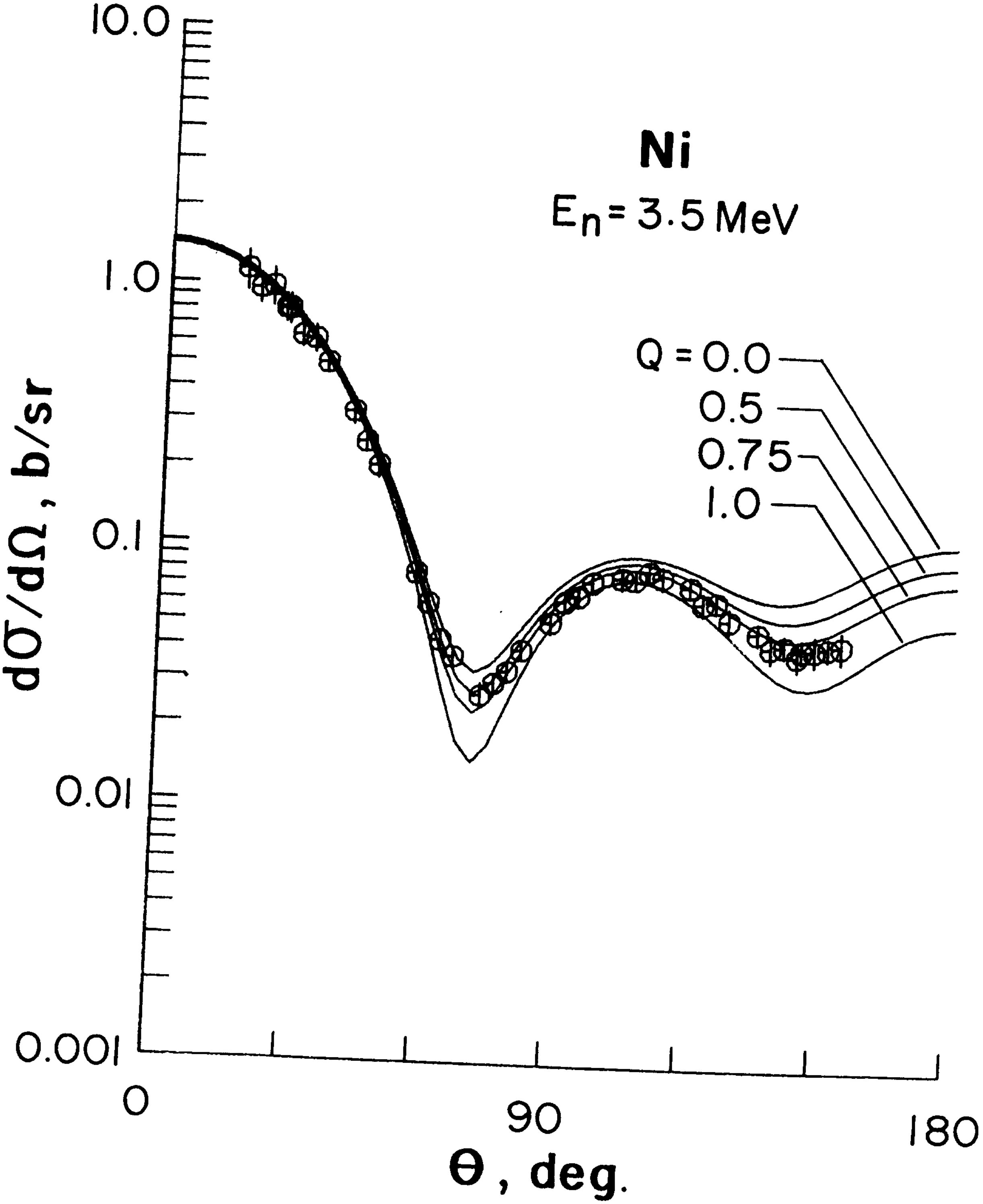


Fig. 6

Fig. 7


Ni
En = 3.5 MeV
Q = 0.0
0.5
0.75
1.0
10.0
1.0
0.1
0.01
0.001
dσ/dΩ , b/sr
0
90
180
θ , deg.

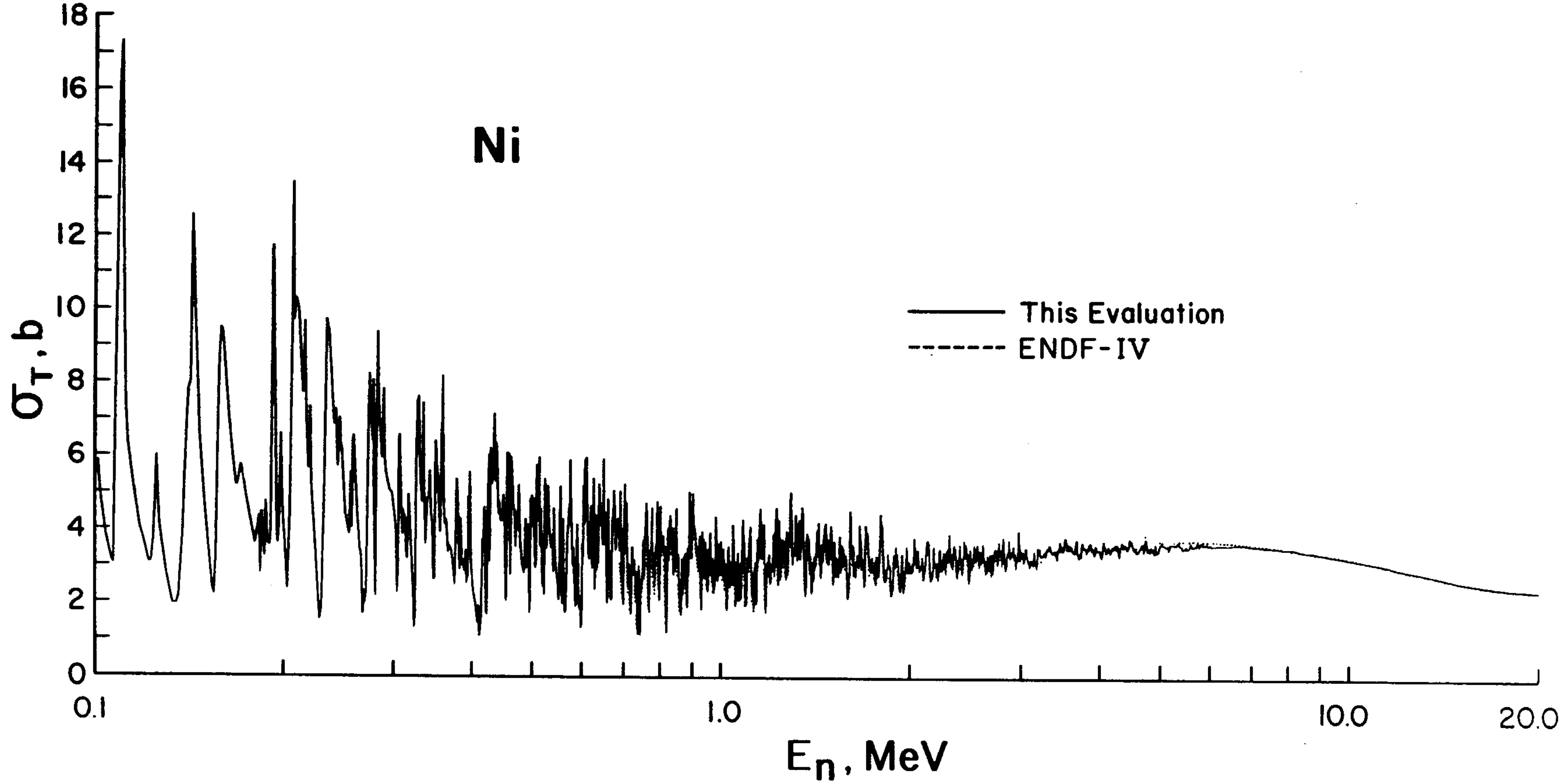

Ni
This Evaluation
ENDF-IV
σ_T, b
E_n, MeV
0
2
4
6
8
10
12
14
16
18
0.1
1.0
10.0
20.0

Fig. 8

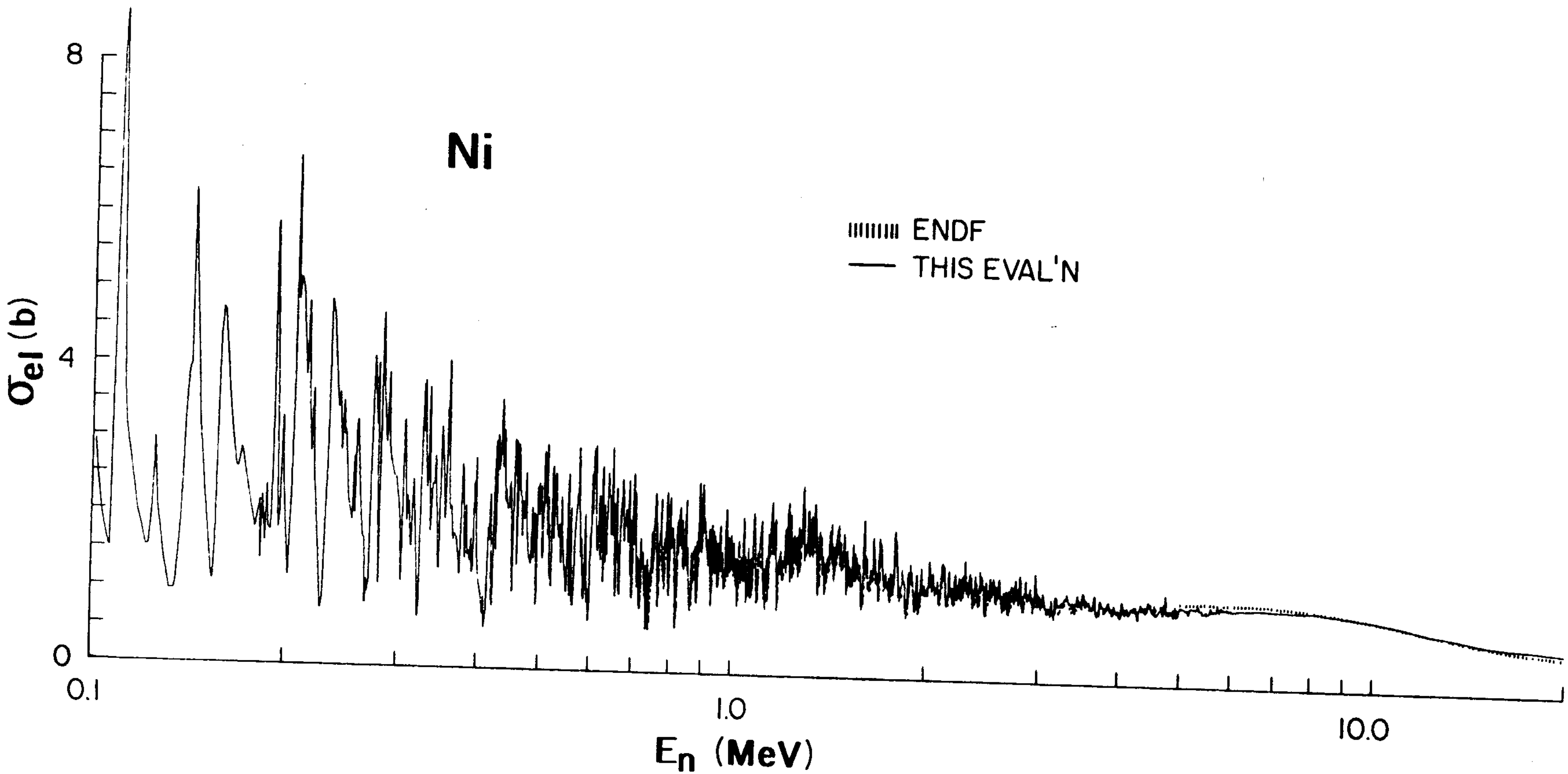
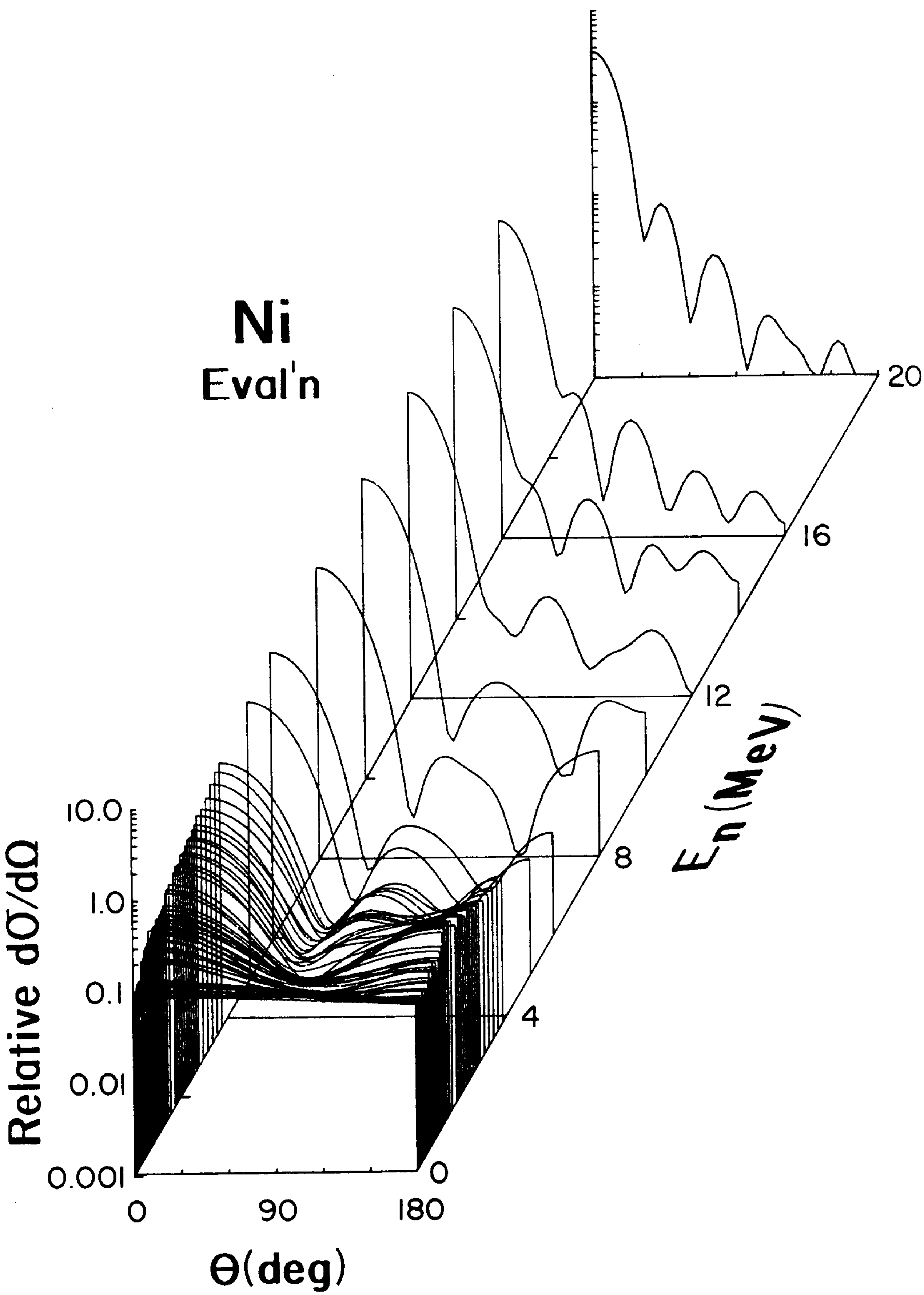


Fig. 9

Fig. 10



Ni
Eval'n
10.0
1.0
0.1
0.01
0.001
Relative dσ/dΩ
0
90
180
θ(deg)
0
4
8
12
16
20
E_n(MeV)

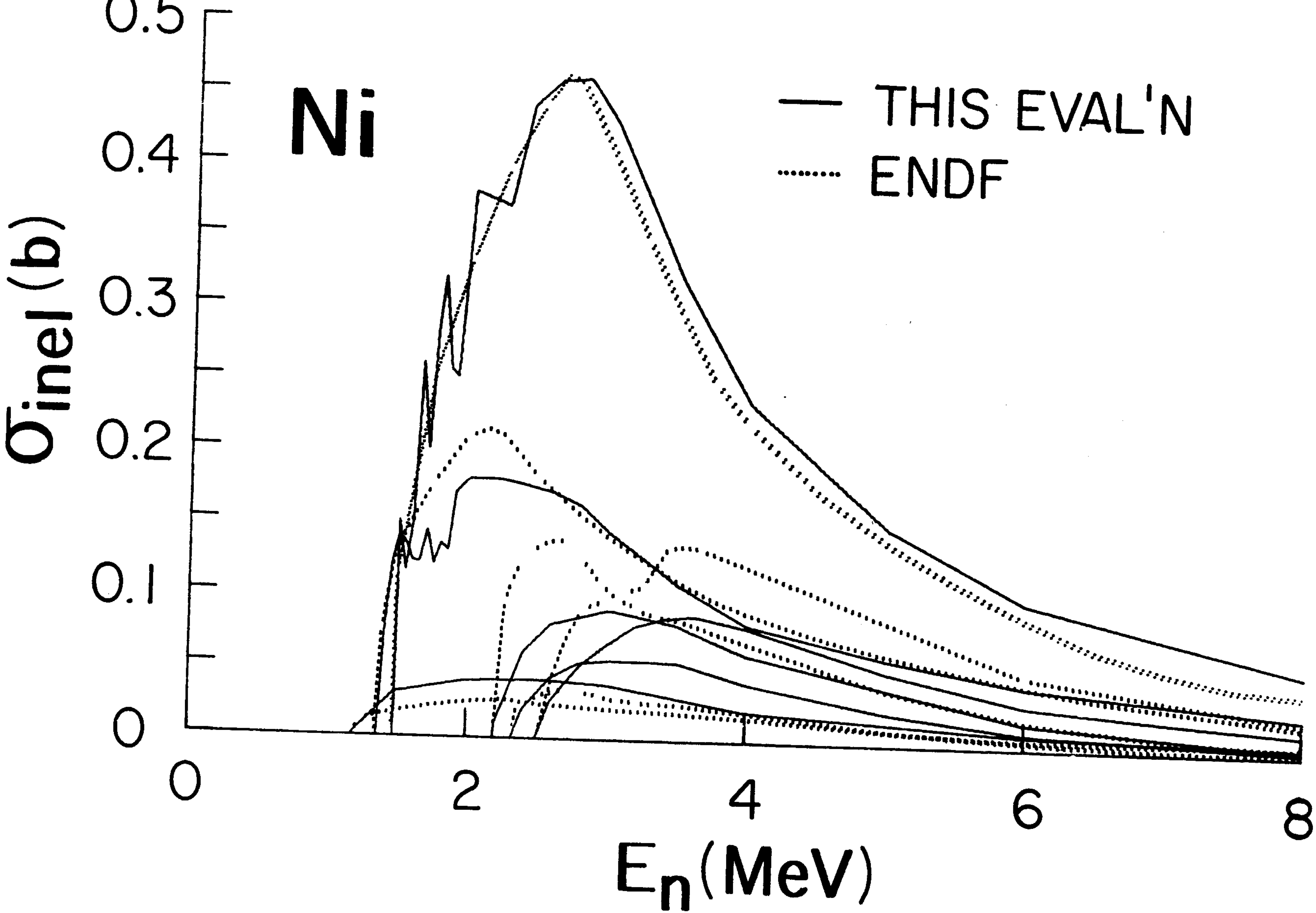


Fig. 11

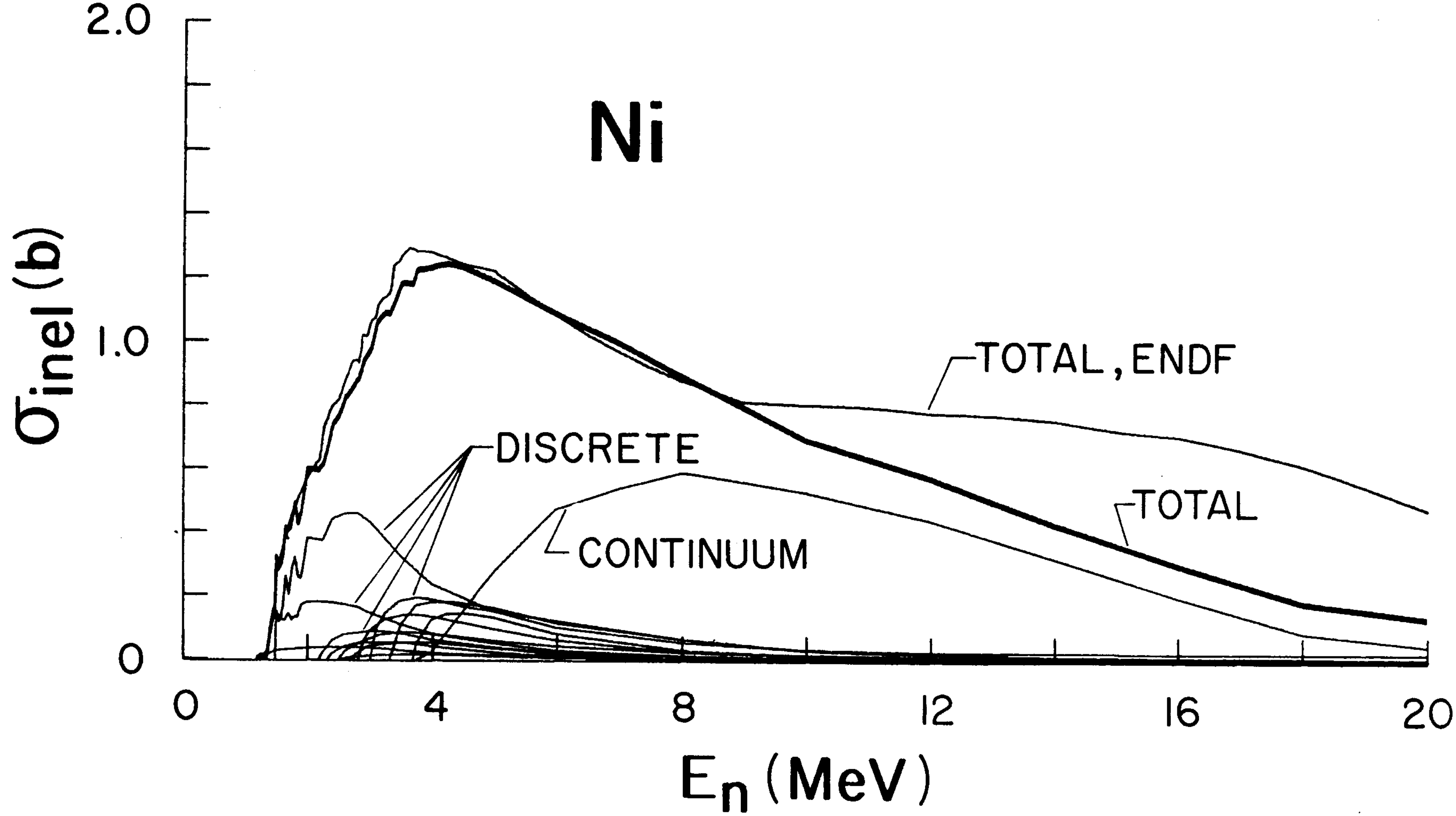

Ni
σ_{inel} (b)
2.0
1.0
0
0
4
8
12
16
20
E_n (MeV)
TOTAL, ENDF
DISCRETE
CONTINUUM
TOTAL

Fig. 12

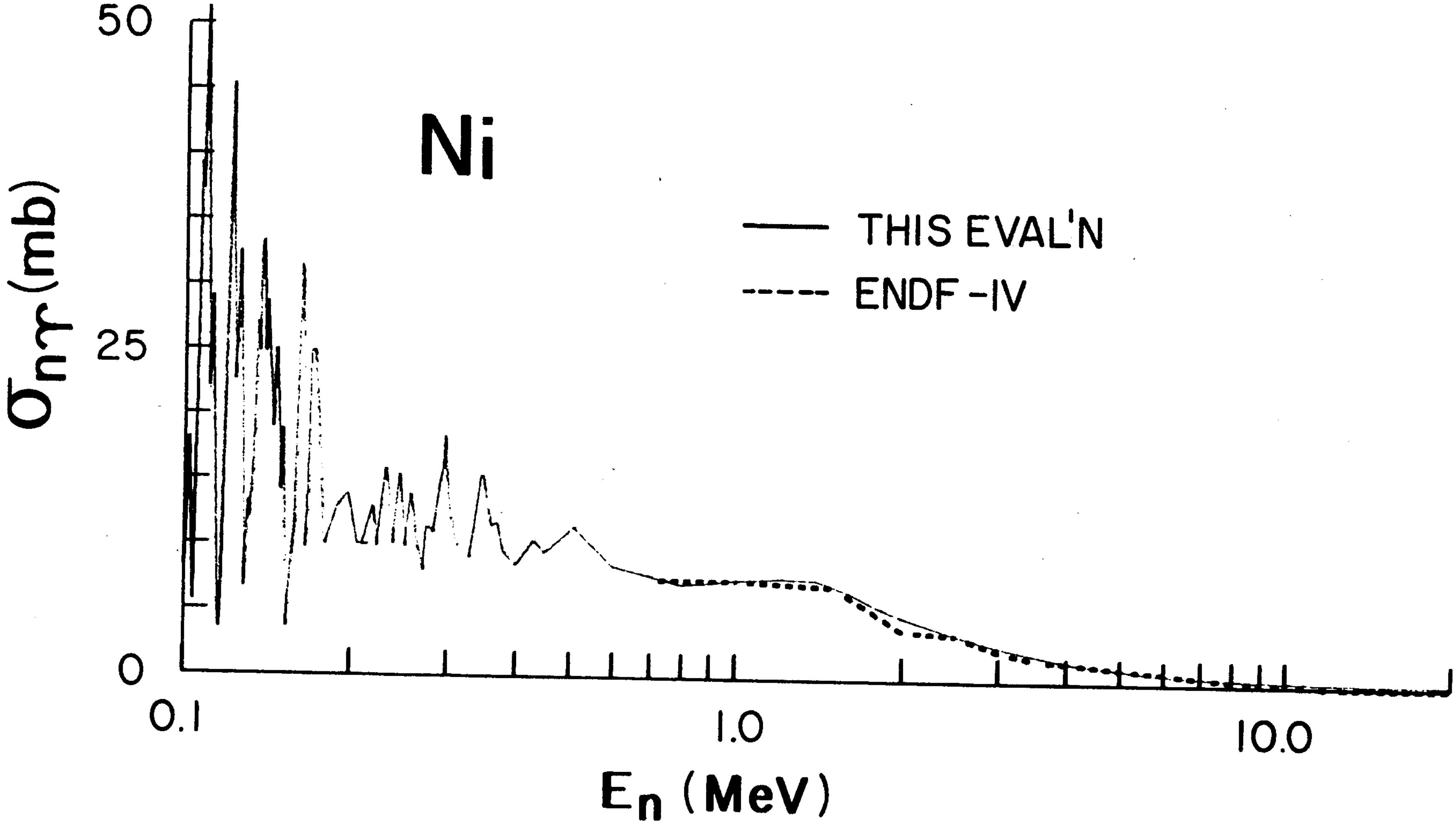


Fig. 13

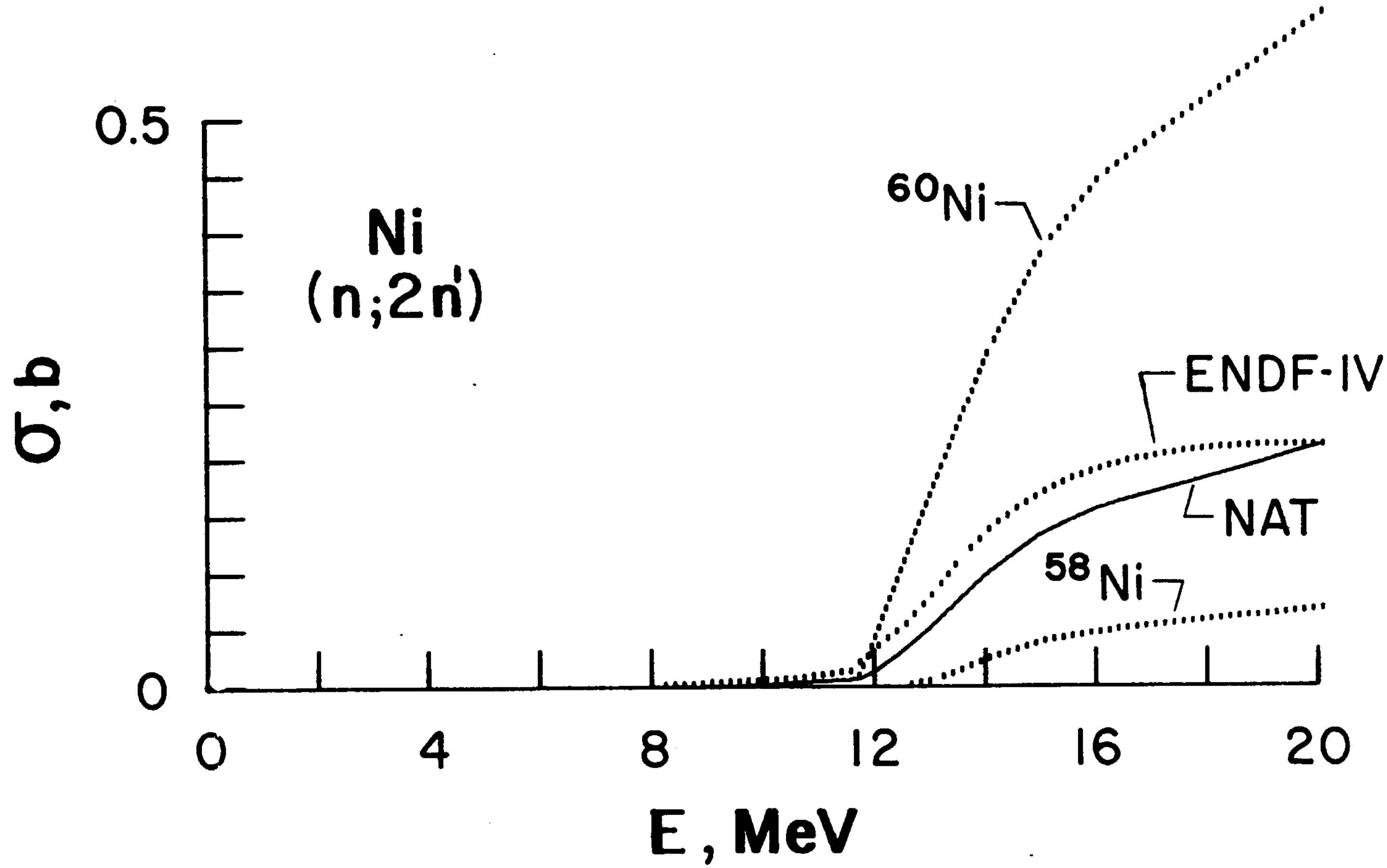
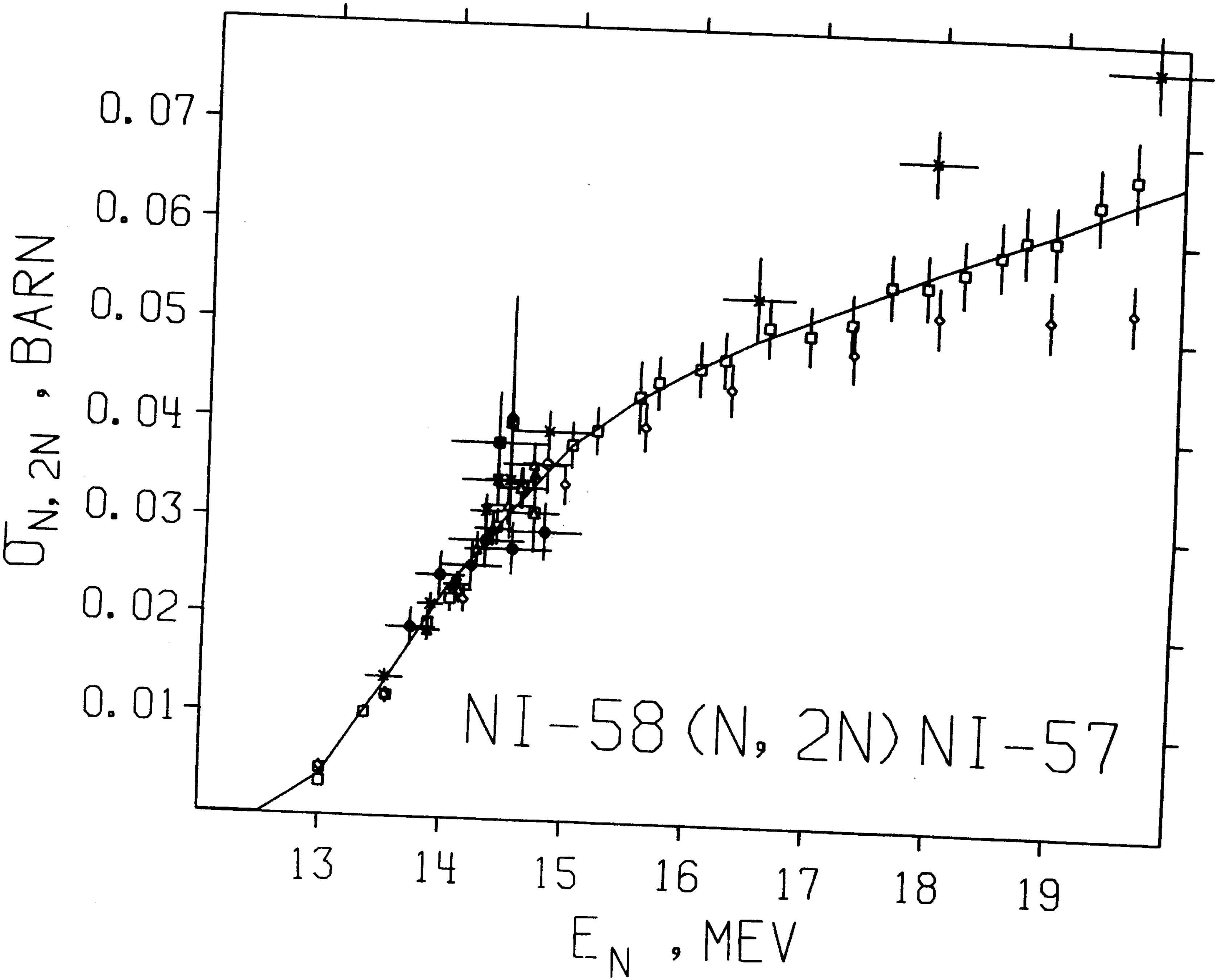


Fig. 14



0.07
0.06
0.05
0.04
0.03
0.02
0.01
$\sigma_{N,2N}$, BARN
13
14
15
16
17
18
19
E_N , MEV
NI-58(N, 2N)NI-57

Fig. 15

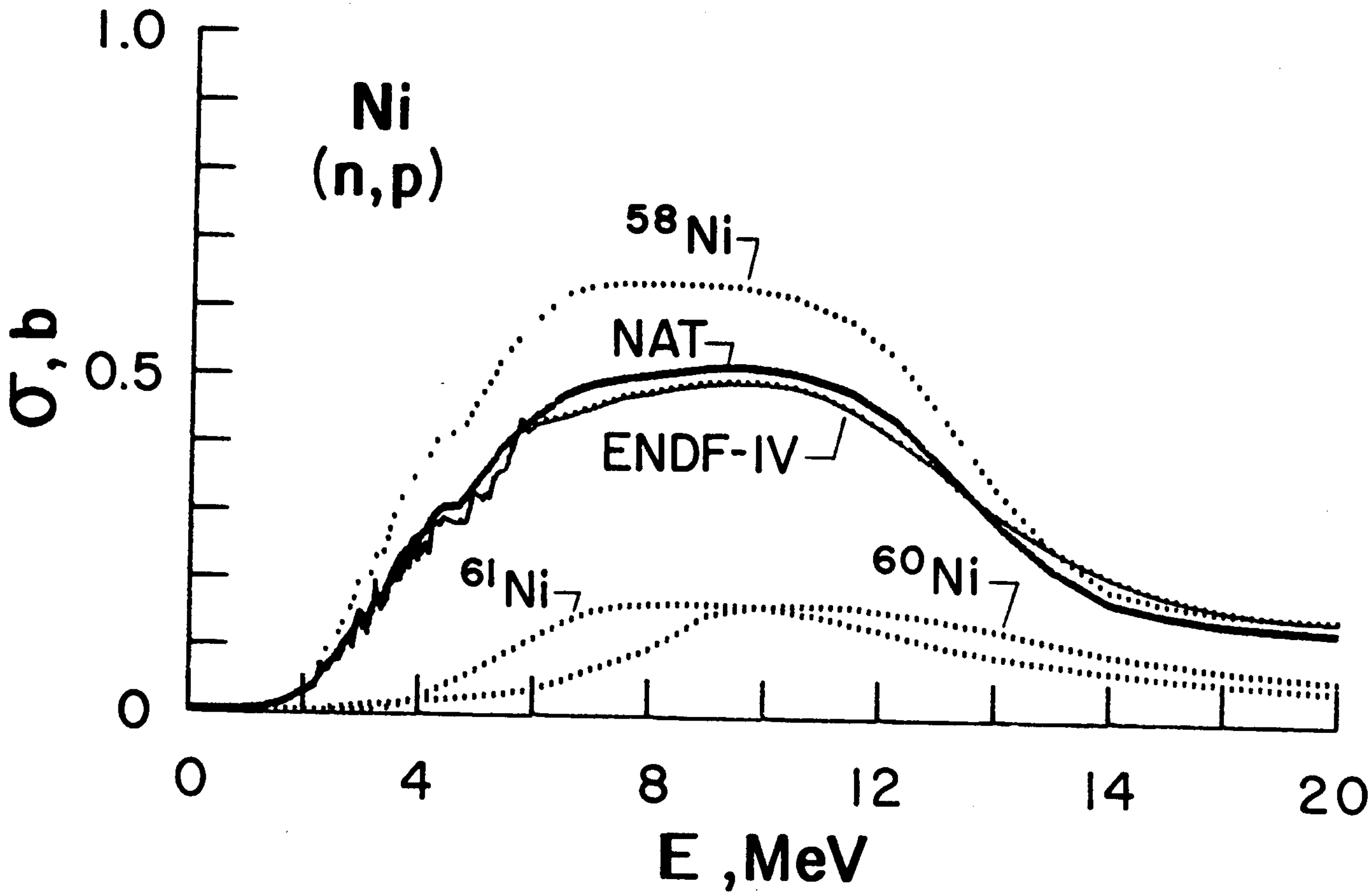


Fig. 16

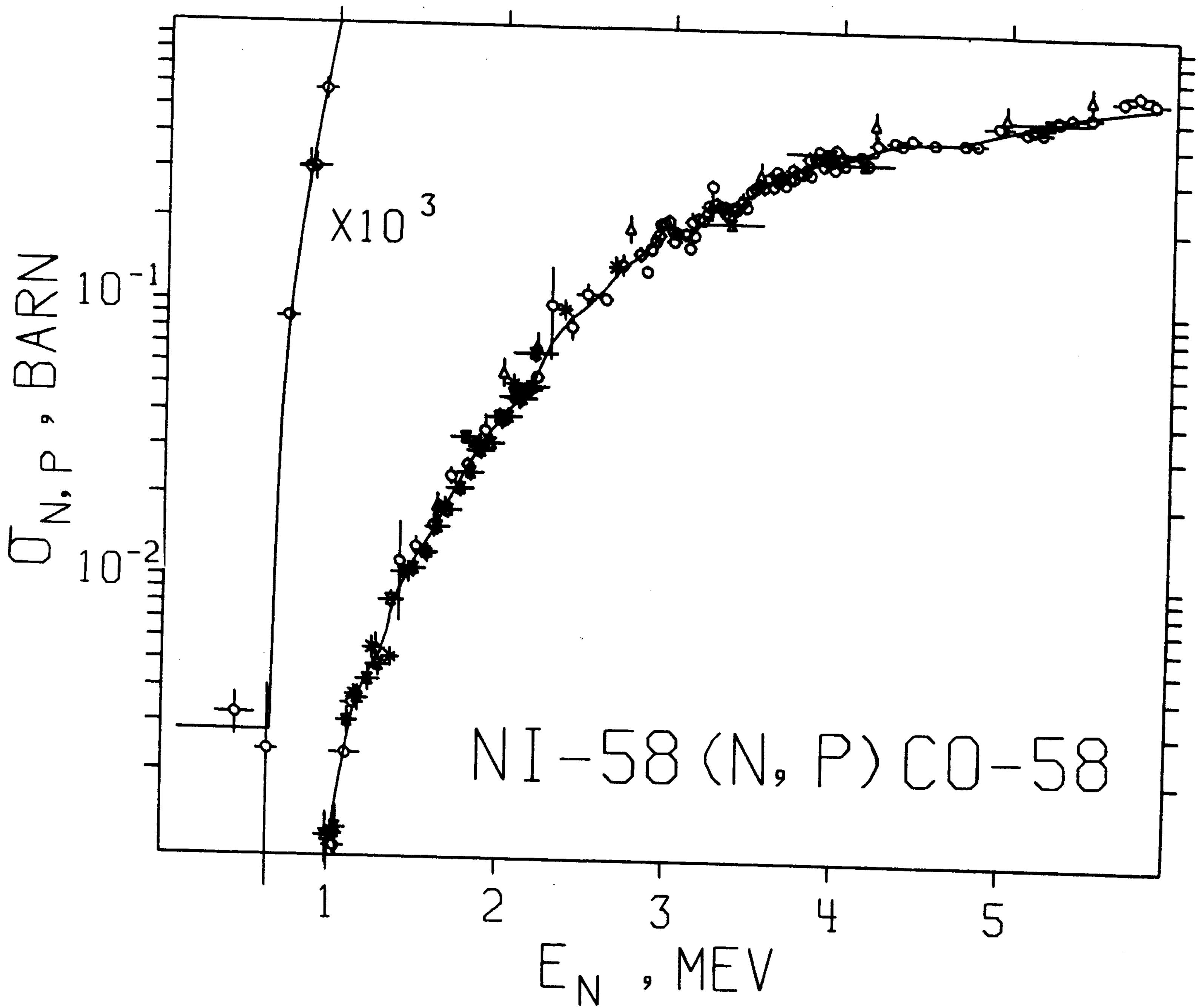


Fig. 17

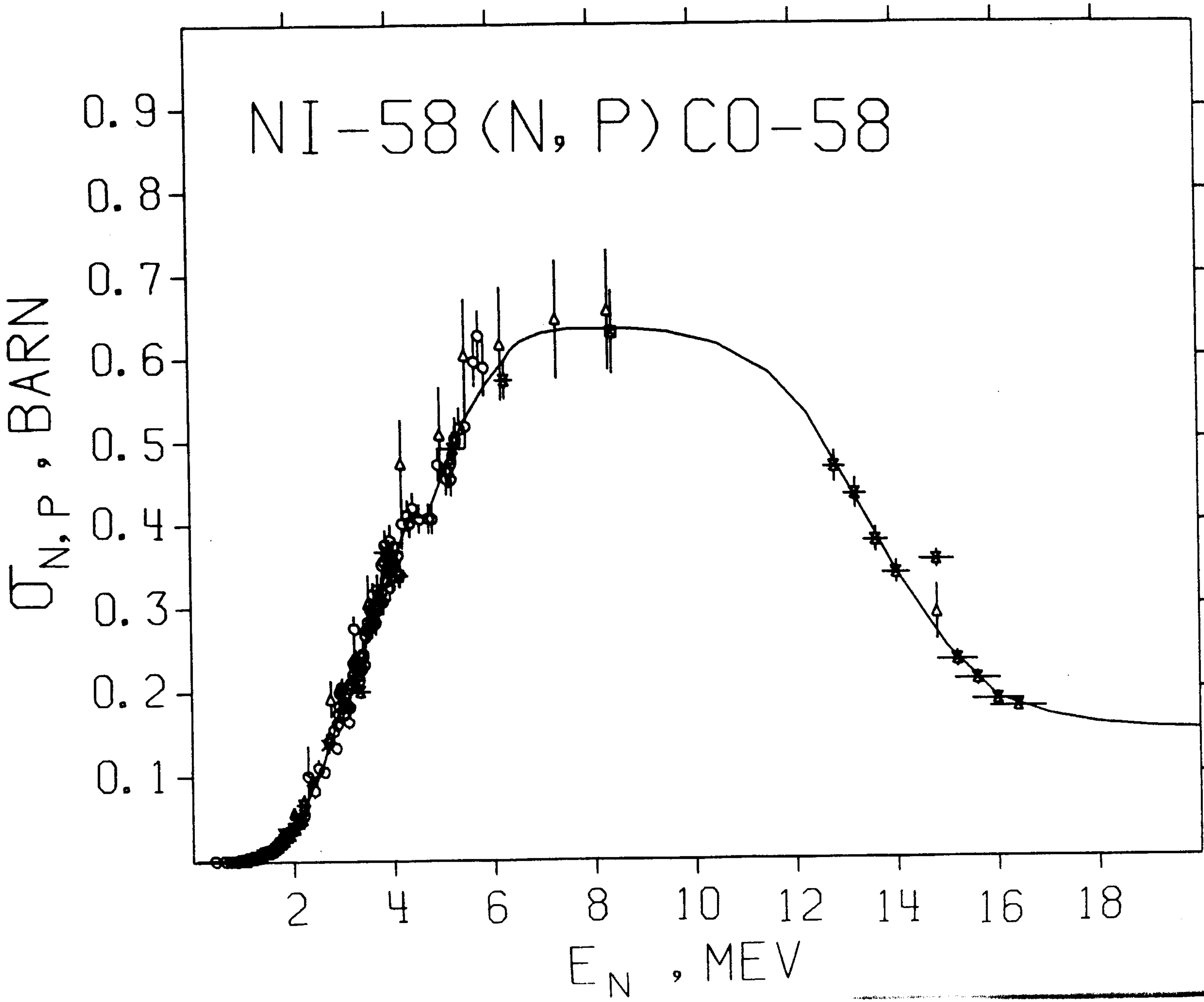

NI-58 (N, P) CO-58
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
$\sigma_{N,P}$, BARN
2
4
6
8
10
12
14
16
18
E_N, MEV

Fig. 18

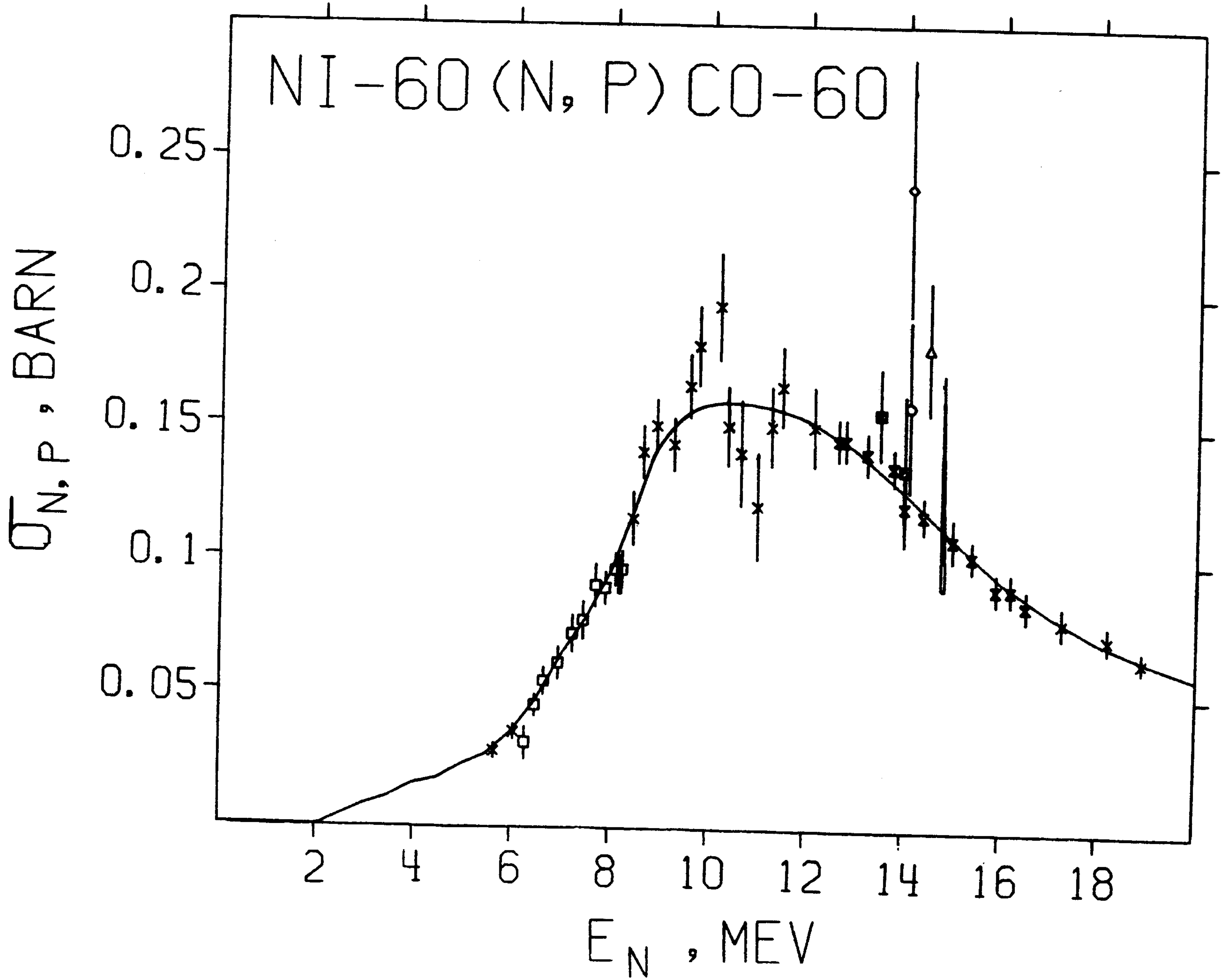

NI-60 (N, P) CO-60
0.25
0.2
0.15
0.1
0.05
$\sigma_{N,P}$, BARN
2
4
6
8
10
12
14
16
18
E_N, MEV

Fig. 19

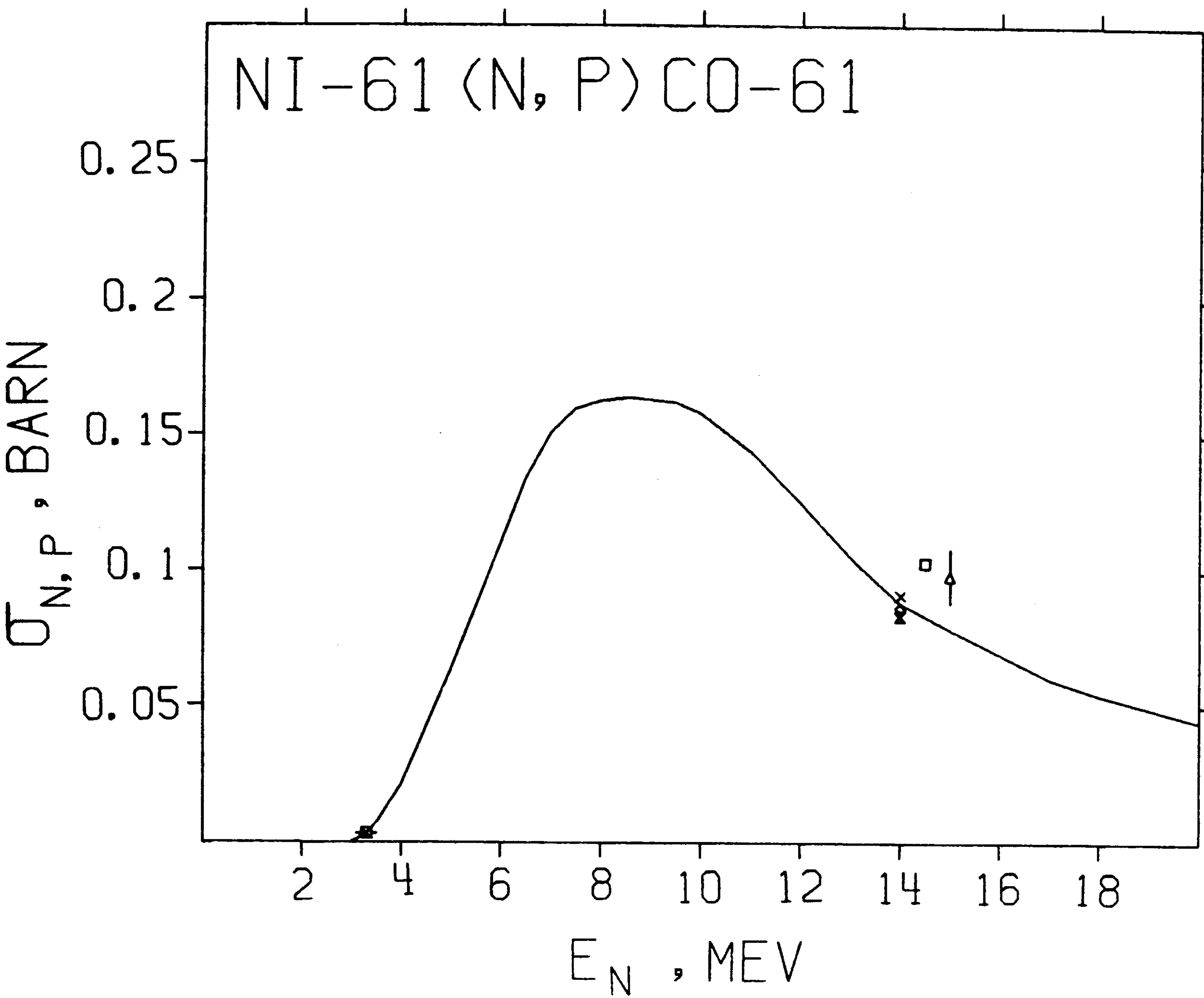


Fig. 20

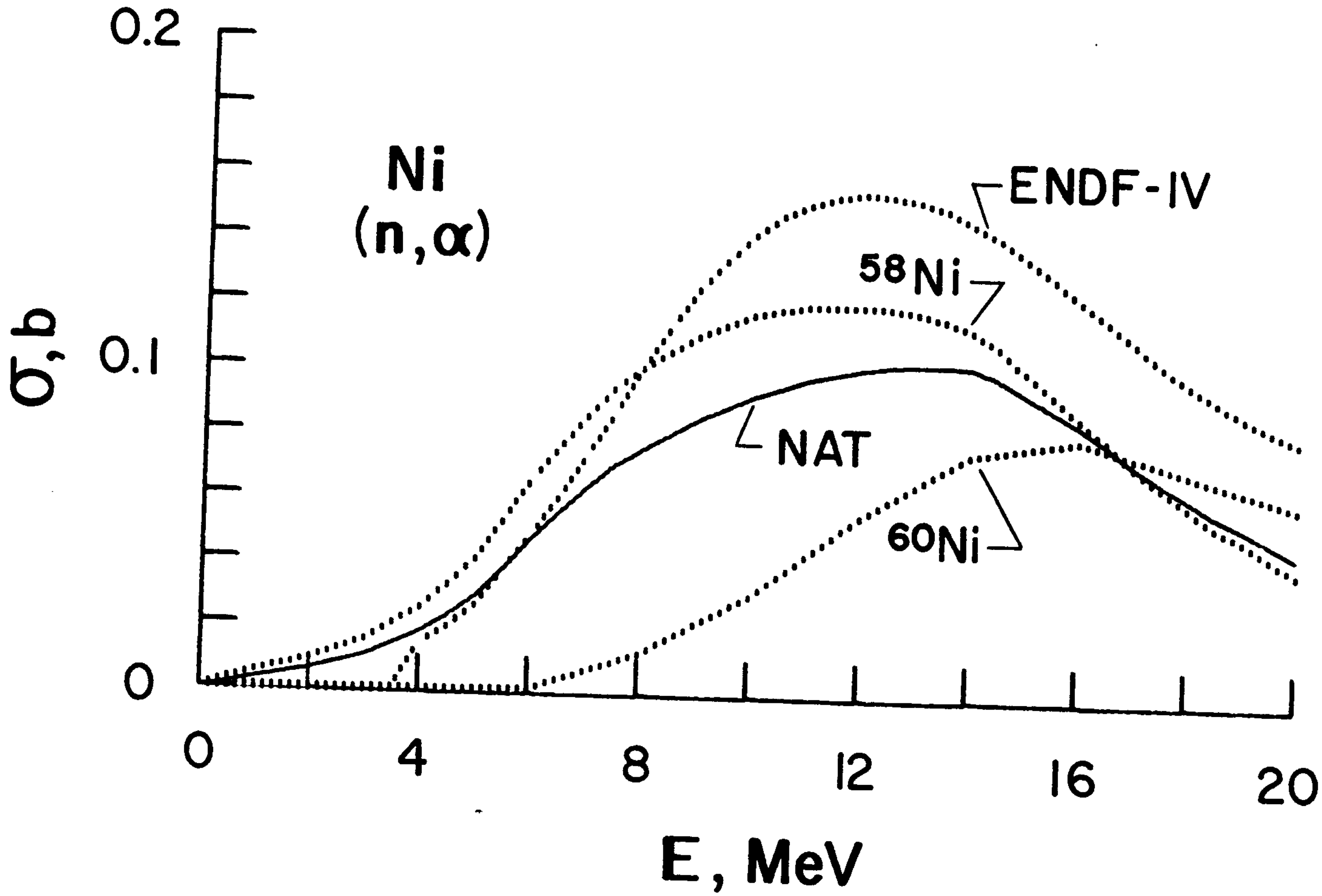


Fig. 21

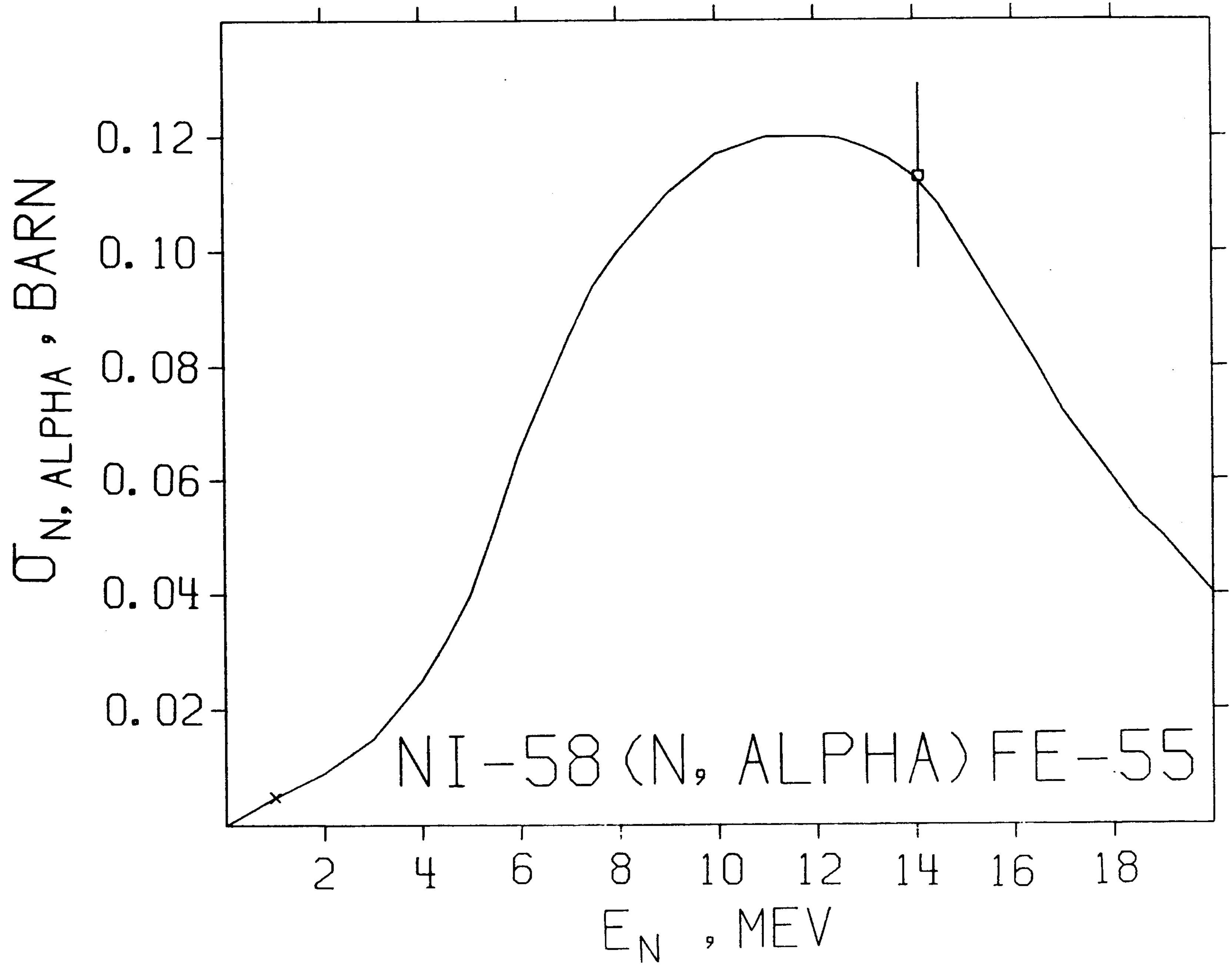

NI-58(N, ALPHA)FE-55
0.12
0.10
0.08
0.06
0.04
0.02
σN, ALPHA , BARN
2
4
6
8
10
12
14
16
18
EN , MEV

Fig. 22

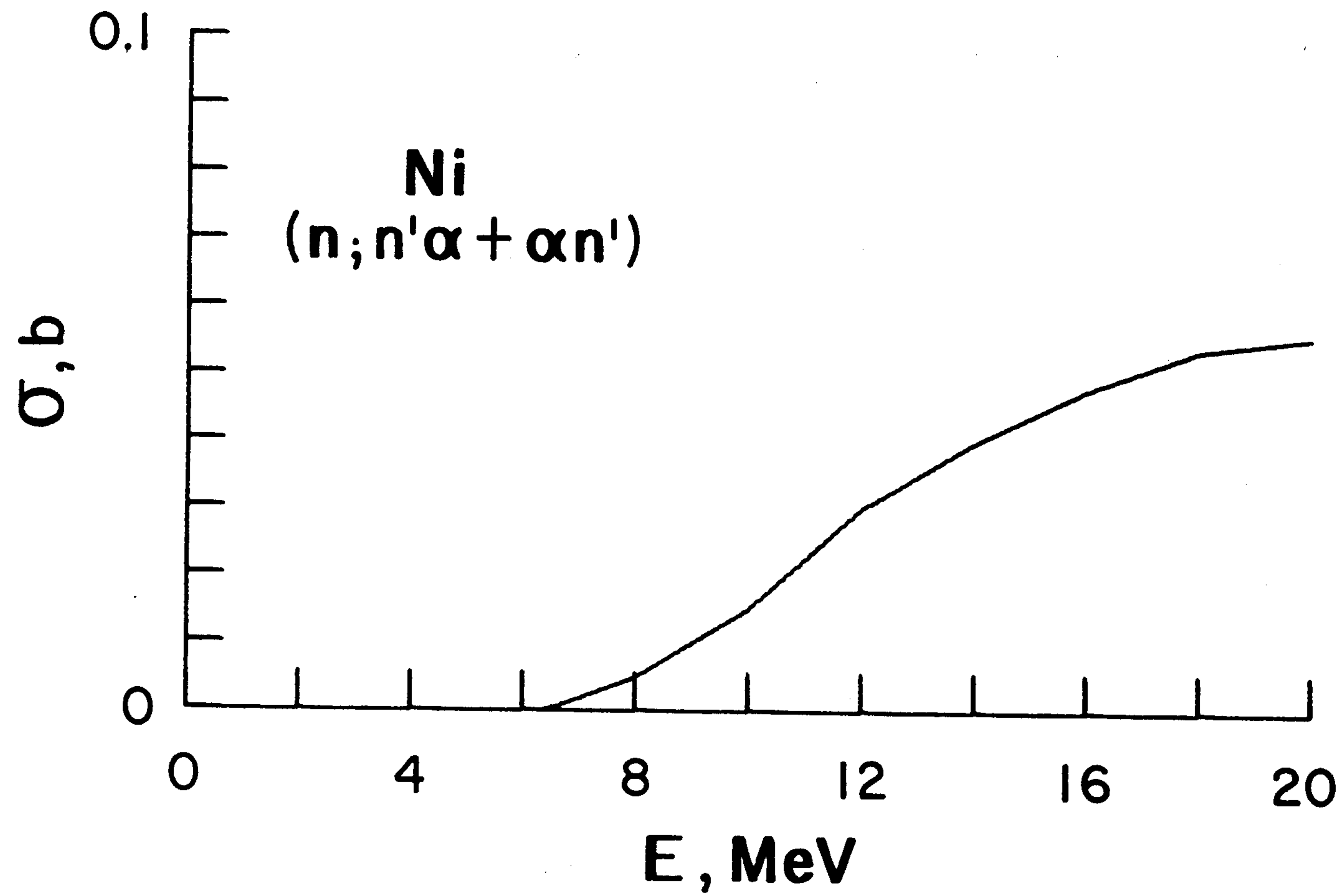


Fig. 23

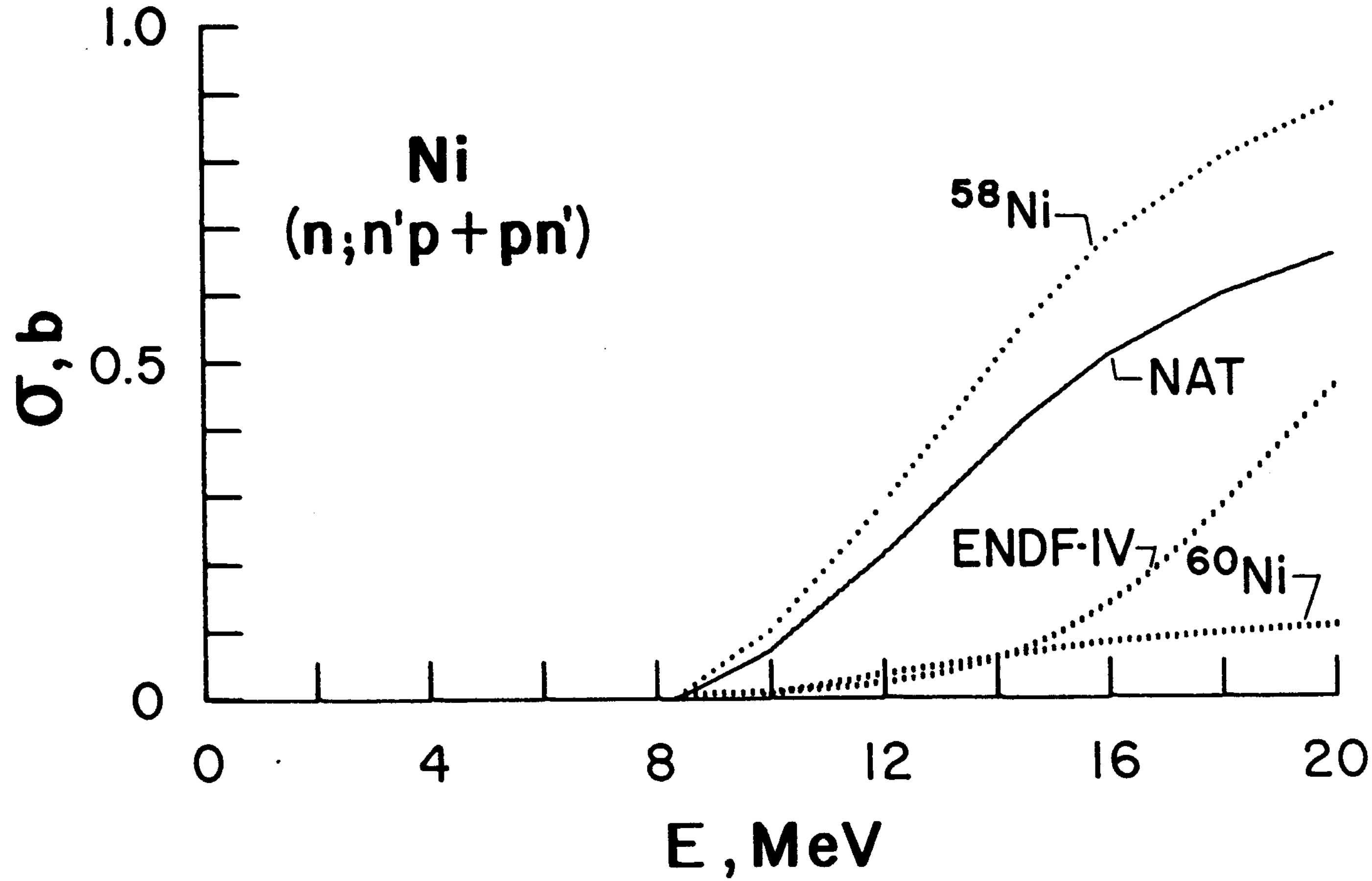


Fig. 24

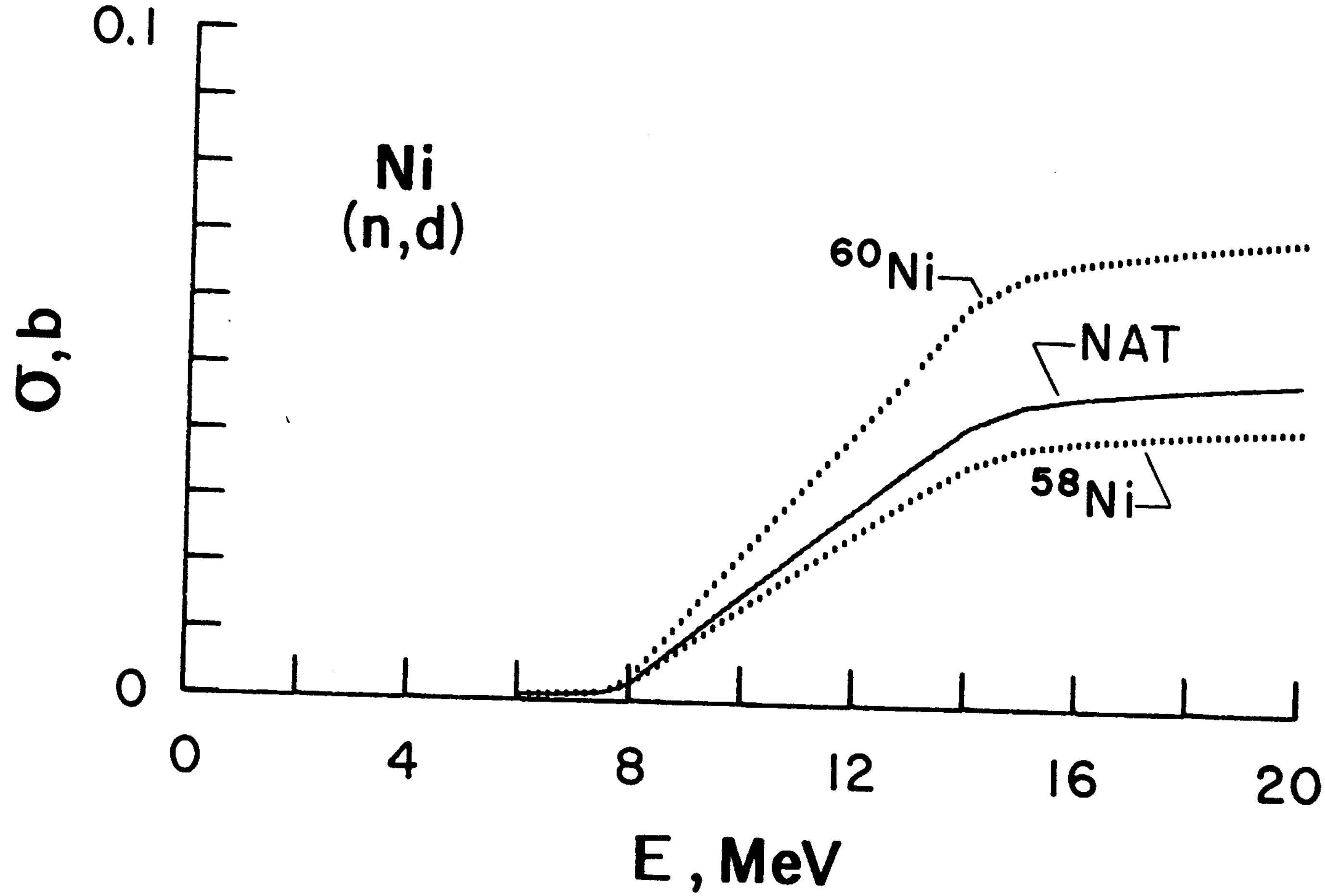


Fig. 25

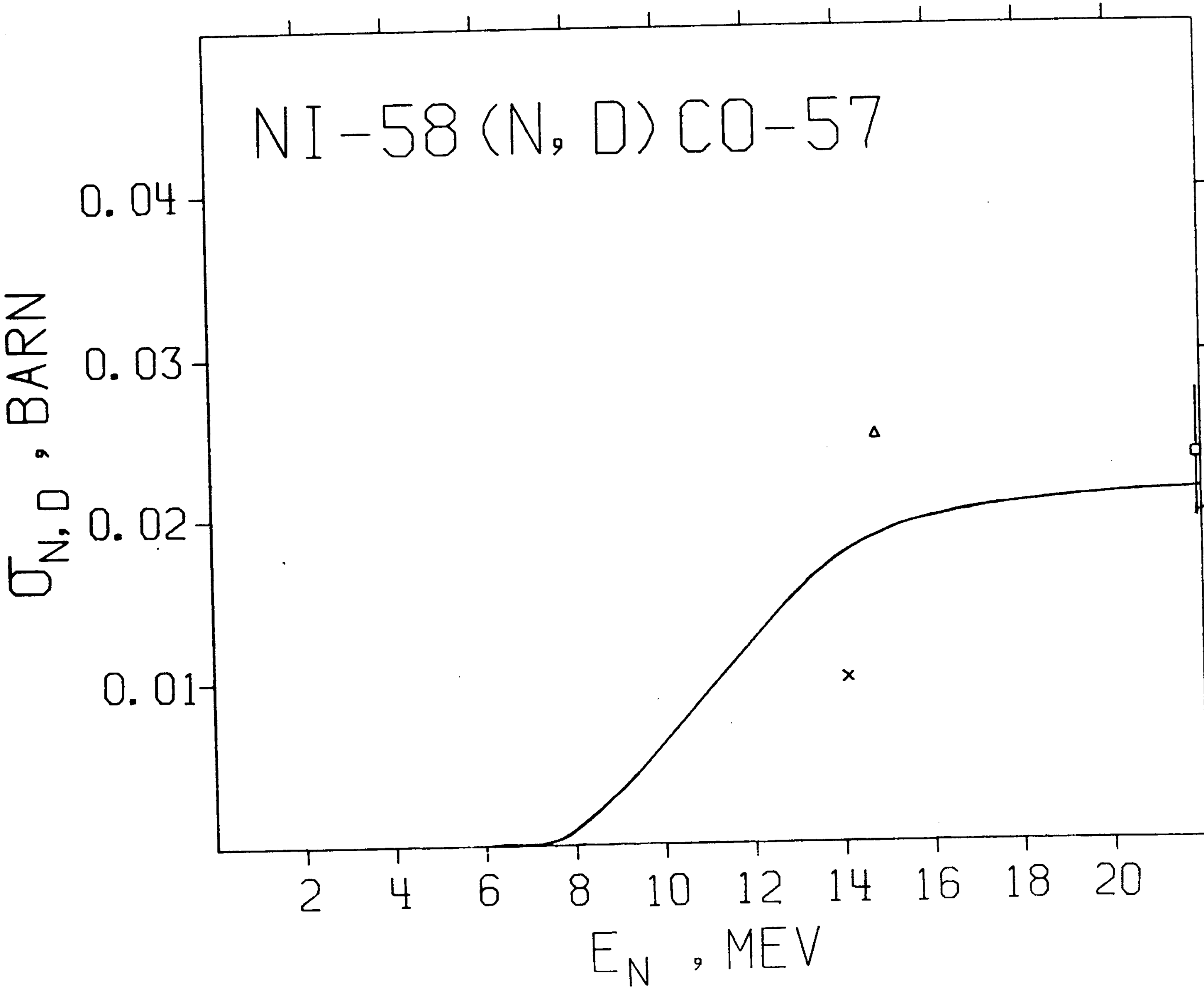

NI-58(N,D)CO-57
0.04
0.03
0.02
0.01
σN,D , BARN
2
4
6
8
10
12
14
16
18
20
EN , MEV

Fig. 26

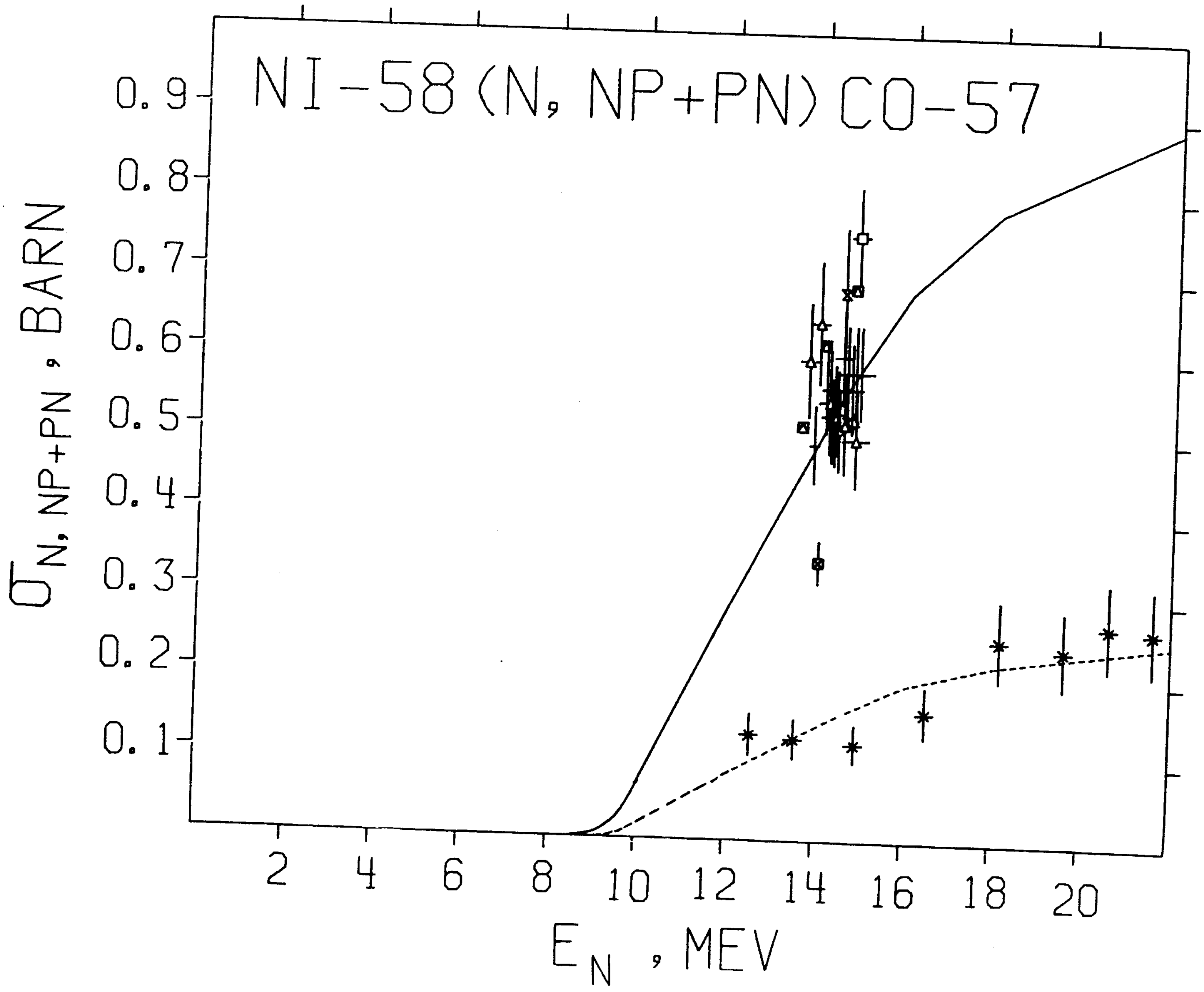

NI-58 (N, NP+PN) CO-57
σ N, NP+PN , BARN
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
2
4
6
8
10
12
14
16
18
20
E N , MEV

Fig. 27

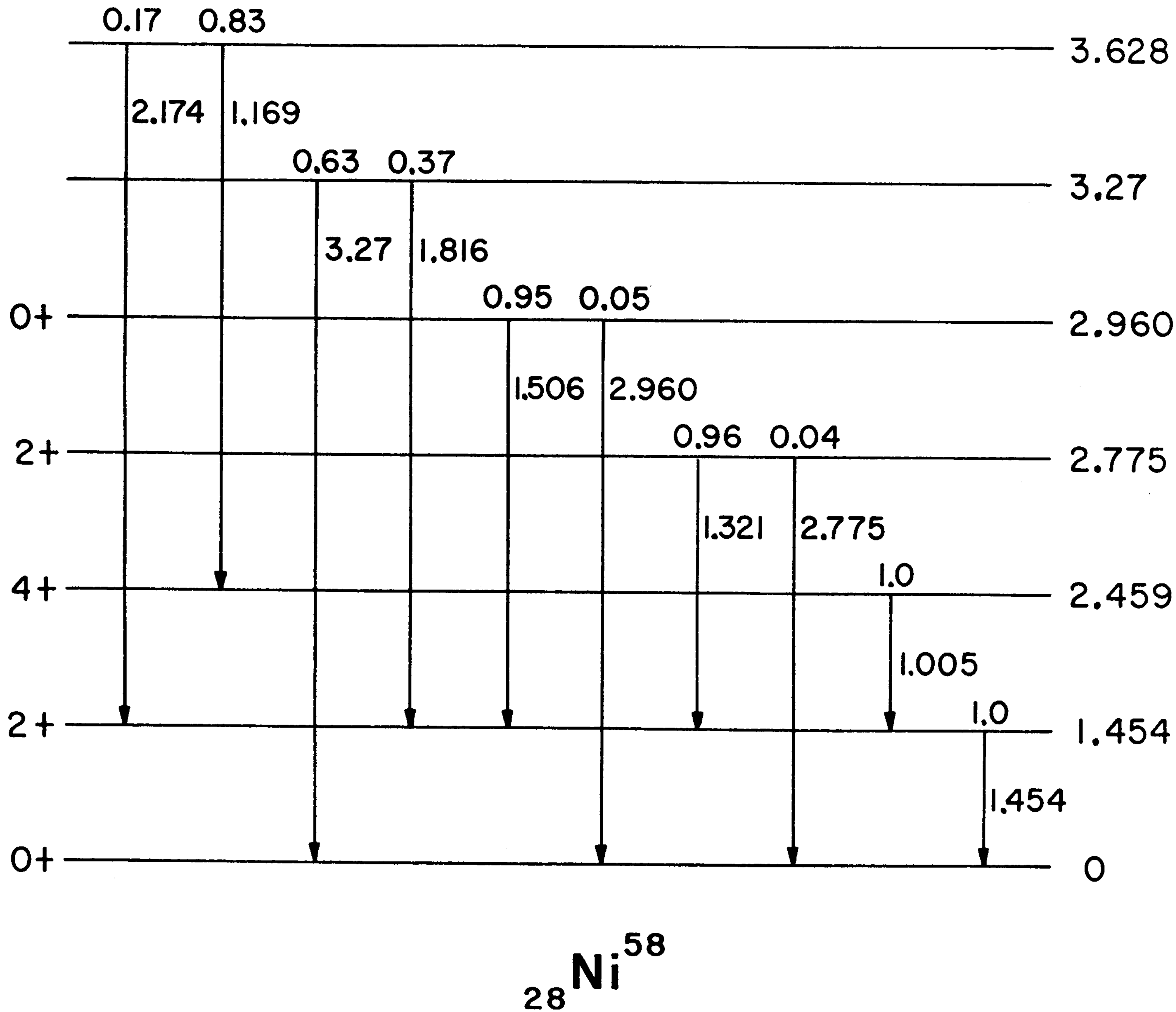
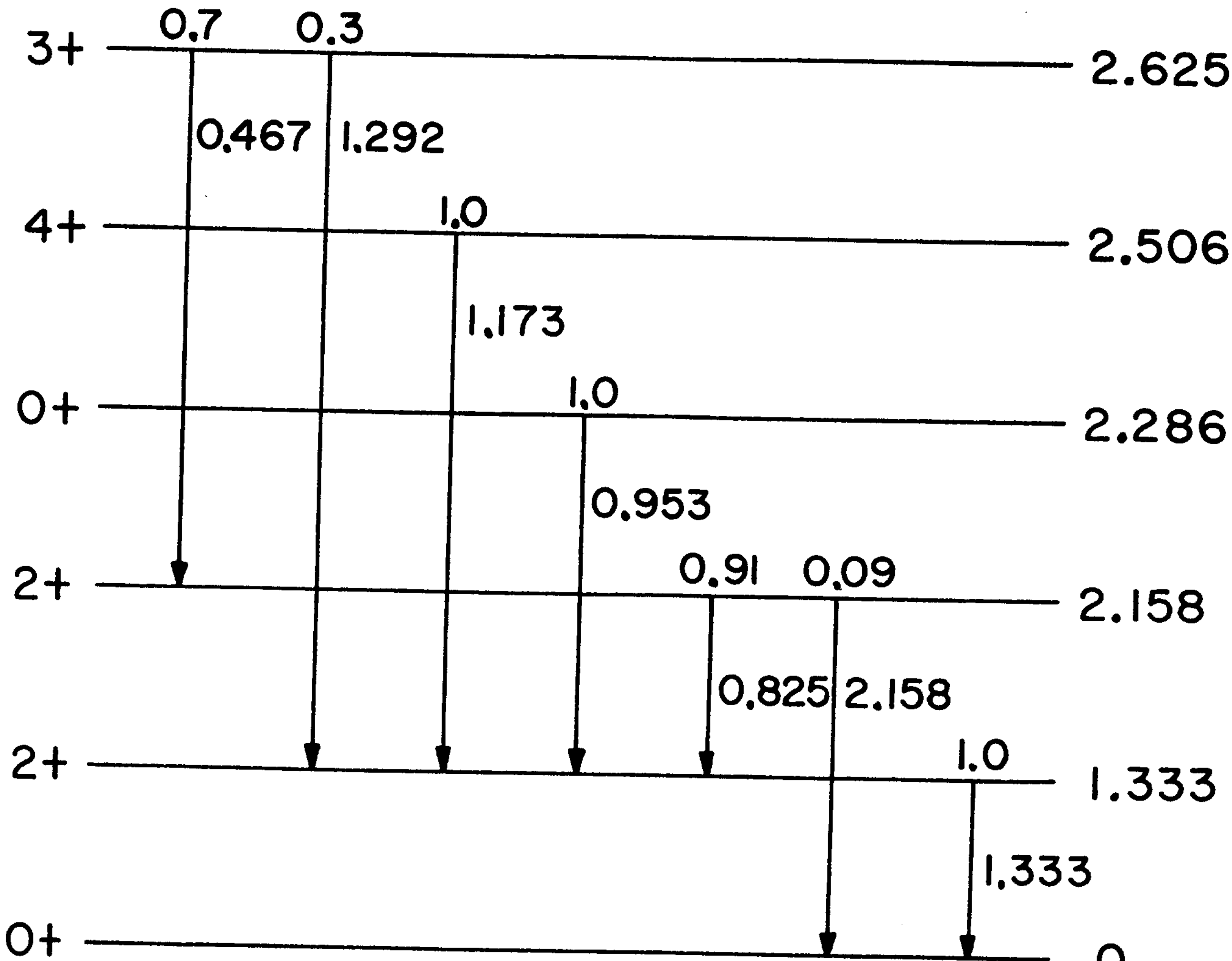

0.17
0.83
2.174
1.169
3.628
0.63
0.37
3.27
3.27
1.816
0+
0.95
0.05
2.960
1.506
2.960
2+
0.96
0.04
2.775
1.321
2.775
4+
1.0
2.459
1.005
2+
1.0
1.454
1.454
0+
0
$_{28}Ni^{58}$

Fig. 28

Fig. 29



$_{28}Ni^{60}$